AN

ILLUSTRATED SYNOPSIS

OF

NORMAL HISTOLOGY:

ADAPTED TO THE COURSE OF PRACTICAL INSTRUCTION

IN THE

UNIVERSITY OF PENNSYLVANIA.

BY

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ILLUSTRATED WITH FORTY PLATES.

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Introductory Note.

To facilitate the laboratory instruction, during the past year the classes have been provided with photographic copies, somewhat reduced, of a series of drawings selected from the author's port-folio. For evident reasons, these were "blue-prints", which, while answering the desired purpose, do not, however, preserve satisfactorily the more delicate detail of the original plates.

In response to the request for the series in a more acceptable form, the present silver-prints, with the accompanying descriptive text, have been prepared. A number of Photo-micrographs have been added. In accordance with the primary object of the series, no pretense to completeness is made.

GEORGE A. PIERSOL.

December, 1884.

List of Plates.

PLATE I.

COLORLESS BLOOD CORPUSCLES.

Fig. 1. The Typical Cell—as represented by the fully matured ovum. (*Diagramatic.*) *a*, cell-wall—*the vitelline membrane; b*, cell-contents—*the yolk; c*, nucleus, enclosed by a distinct nuclear-membrane,—*the germinal vesicle; d*, nucleolus—*the germinal spot.*

Fig. 2. Colorless blood corpuscles of frog; × 900. *a*, cell in condition of absolute rest; *b–d*, as usually observed, exhibiting *amœboid movements.* In these cells, cell-contents and nucleus alone are present—these being the only really essential parts of the cell.

Fig. 3. Active white blood cell of frog; × 450. The figures accurately portray the actual changes observed in a corpuscle, on the warm-stage, within forty minutes. At *g* and *h*, a new cell has just been given off by direct division on the part of the parent cell.

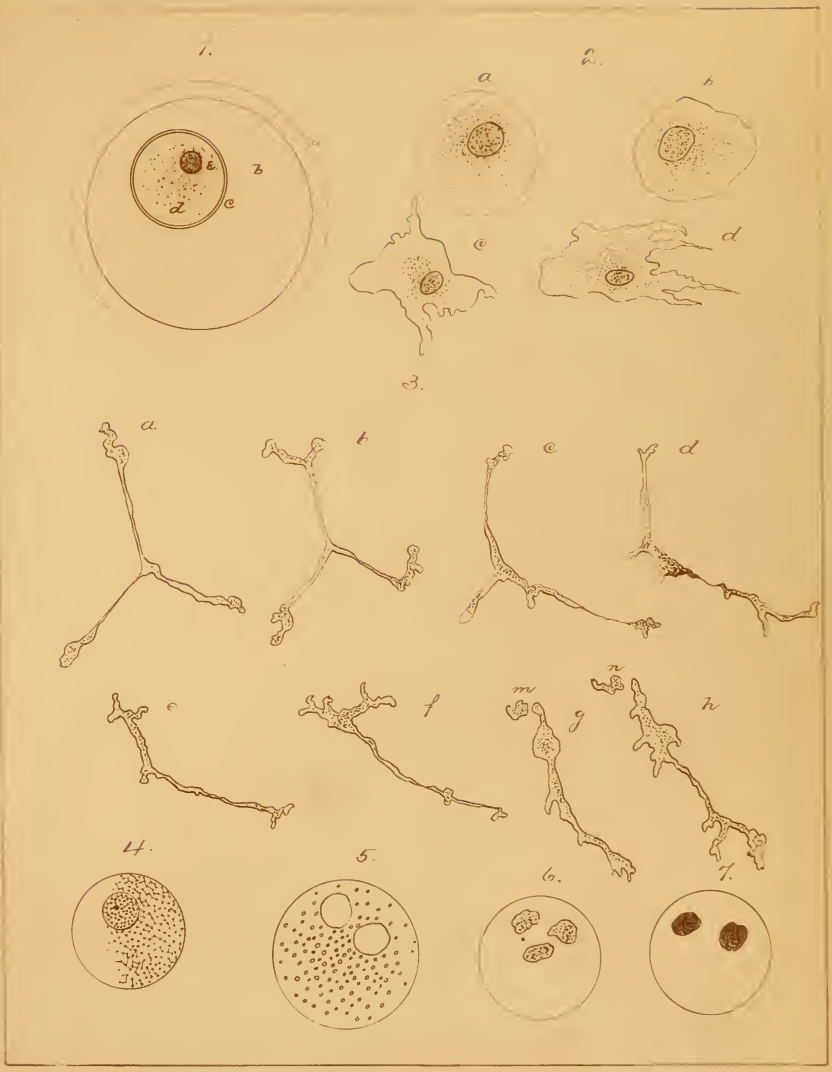
Fig. 4. Diagram representing the intimate structure of living matter as held by Heitzmann, Klein, and others; the *intracellular networks* being shown.

Fig. 5. White blood cell treated with *water;* × 900. The cell increases in size; granular cell-contents clears up, and the contained particles exhibit the *Brownian movement.*

Fig. 6. White blood cell after the addition of *acetic acid;* × 900. Cell-contents has entirely cleared up, revealing the multiple nuclei.

Fig. 7. White blood cells treated with *aniline-red;* × 900. Nuclei deeply stained, while the cell-contents is but slightly tinged.

PLATE I.



COLORLESS BLOOD CORPUSCLES.

PLATE II.

RED BLOOD CORPUSCLES.

(*Figures diagramatic.*)

Fig. 1. Corpuscle of man. *a*, front view; *b*, profile view. Type of mammalian, *non-nucleated*, red blood corpuscles.

Fig. 2. Corpuscle of frog. *a* and *b*, front and profile views. Type of the *nucleated* red cells.

Figs. 3, 4. Effect of the addition of *saline* solutions. *a*, after weak solutions, resulting in the "crenated" form; *b*, more marked distortion; *c*, fully shrunken cells, after the action of concentrated brine.

Figs. 5, 6. After *water*. Coloring matter extracted, the corpuscles becoming bleached, and almost invisible—"ghosts." At the same time, the cell becomes somewhat larger, and spherical instead of discoidal. The nuclei, in the frog's blood, become more prominent.

Figs. 7, 8. After *acetic acid*. The cells become almost invisible, being completely bleached, as well as spherical; the nuclei, when present, become more apparent. If *aniline-red* be now added, faint rosy rings indicate the outlines of the cells, the nuclei, in frog's blood, staining deeply.

Fig. 9. Human corpuscle after *tannic acid*—½ p. c. solution. Hæmoglobin coagulated on the exterior of the cell as it escapes from the stroma.

Fig. 10. Similar cell treated with 25 p. c. solution of *potassium bichromate*, causing the appearance of pseudo nucleus and cell-wall.

Figs. 11, 12. Changes noted in human corpuscles on being sealed 24 hours.

Fig. 13. Minute particles found normally in blood, the exact significance and nature of which are still undetermined.

Fig. 14. The delicate *fibrin* filaments, seen in preparations after standing.

Fig. 15. Hæmin crystals from man. *a*, *b*, usual forms. Brown in color, and varying in size, according to rapidity of their production. These crystals show simply the presence of blood, having no value in differentiating the particular kind from which they were obtained.

PLATE II.

RED BLOOD CORPUSCLES.

PLATE III.

VARIETIES OF EPITHELIUM.

(*Figures diagramatic.*)

Fig. 1. Superficial squamous cells, from the mouth. *a*, profile view of a cell. Cells often covered with forms of bacteria, and usually contain oil drops. *b*, a "salivary corpuscle"—probably a leucocyte swollen by fluid of low S. G., and now exhibiting the Brownian movement, similar to the reaction with water.

Fig. 2. Simple squamous (pavement) epithelium, skin of frog.

Fig. 3. Simple columnar epithelium. *a*, profile view of cells; the protoplasm of one of which has undergone mucoid change, resulting in the formation of a "*goblet*" cell. *b*, surface view of same cells.

Fig. 4. Stratified squamous. *a*, *basement membrane*, upon which the young cells rest, these latter being low-columnar; passing towards the free-surface, their shape gradually is modified, the long axes of the cells lying, finally, generally parallel to the surface of the mucous membrane. Outer cells scaly.

Fig. 5. Stratified columnar, from trachea. Superficial cells here are *ciliated.*

Fig. 6. "Transitional" epithelium, as found in the bladder.

Fig. 7. "Prickle" cells, from the middle layers of stratified squamous epithelium—especially well seen in the pathological epithelial formations.

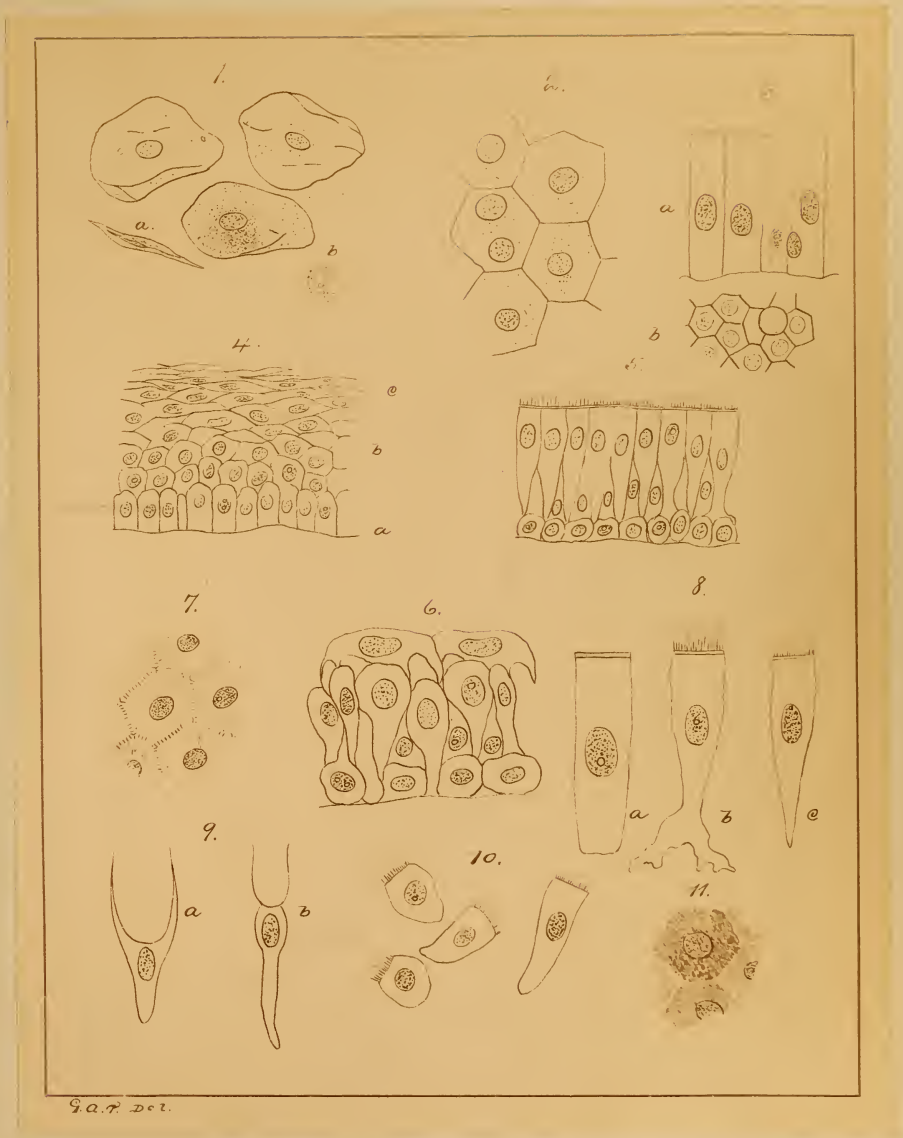
Fig. 8. Types of columnar cells. *a*, from a simple, *b*, *c*, from a stratified epithelial structure.

Fig. 9. "Goblet" cells; protoplasm replaced by mucoid substance, and nucleus crowded to one end. *a*, as seen in the cat's intestine; *b*, from the œsophagus of the frog.

Fig. 10. Ciliated cells, pharynx of frog.

Fig. 11. Pigmented cells, of retina. The entire cell occupied with small particles of melanin, the nuclei, however, remain almost uninvaded.

PLATE III.



VARIETIES OF EPITHELIUM.

PLATE IV.

ENDOTHELIAL SURFACES.

Fig. 1. Cells from the peritoneal surface of the diaphragm of rabbit; × 350. In all the figures of this plate, the intercellular cement substance has been stained with silver nitrate, thus sharply mapping out the cells. A few nuclei are visible—unless the tissue be fresh, and the staining intense, these, ordinarily, are distinguished with difficulty.

Fig. 2. Cells lining a small blood-vessel, omentum of rabbit; × 200.

Fig. 3. Cells from a lymphatic-vessel, mesentery of frog; × 200.

Fig. 4. Cells covering the trabeculæ of the omentum, of rabbit; × 300.

Fig. 5. Cells covering the peritoneal surface of the septum separating the peritoneal cavity from the large lymph-space in the abdomen of frog; × 300. At *a*, there exist true openings in the membrane—*stomata*, which are surrounded and lined by small cells. Depending upon the condition of these, as well as upon the general tension of the membrane, these openings appear patulous or closed. At *b*, are seen several *pseudo-stomata*—minute deeply stained areas, situated between adjacent endothelial plates.

Figs. 6, 7. Lymphatic spaces of the corneæ of frog and of kitten; × 300. These spaces—common to all dense connective-tissues—in the frog, contain each one plate-like connective-tissue cell: in those of the kitten, we find the wall of a single space covered by two, or more, such cells, their lines of juncture appearing identical with similar lines of endothelium. If, now, we consider the microscopic lymph-space of connective-tissue to be expanded into a great cavity, as that of the peritoneum, we can readily conceive that the few plates, sufficing for a lining in the first case, may be replaced by thousands of cells in the latter situation, whose outlines, by mutual pressure and arrangement, become polygonal, resulting in typical endothelium.

PLATE IV.

ENDOTHELIAL SURFACES.

PLATE V.

CONNECTIVE TISSUE.

Fig. 1. Embryonal connective-tissue from the umbilical cord, of pig; × 350. The cellular element here predominates, being represented by numerous large plate-like cells. The intercellular substance is gelatinous, containing but few well developed fibres.

Fig. 2. Growing connective-tissue, of kitten; × 350. Cellular elements still active and numerous, with, however, a marked increase in the fibrous intercellular substance. In this tissue, all elements of connective-tissue are present.

CELLULAR:–		INTERCELLULAR:–	
Fixed cells,	(*b*)	*White fibrous tissue*,	(*c*)
Wandering cells,	(*a*)	*Elastic tissue*,	(*c*)

Fig. 3. Diagram illustrating the "*direct*" mode of the formation of fibrous tissue, by the gradual modification and eventual splitting-up of the protoplasm of the cells into fibres.

Fig. 4. The "*indirect*" mode, where the fibres originate from a mass previously deposited by the cells.

Fig. 5. Adult connective-tissue, of cat; × 350. The cells are represented by little more than small nuclei, while the fibrous element has increased.

Fig. 6. Elastic tissue from the ligamentum nuchæ, of ox; × 350. A teased fragment, which exhibits the anastomosing fibres, and their curled free ends.

Fig. 7. Connective-tissue cells from the cornea, of rabbit; × 500. Gold preparation. The cells, by their anastomosing processes, form a network of protoplasmic threads: the cells, with processes, lie within the lymph-spaces of the tissue, whose forms are, usually, irregularly stellate.

PLATE V.

CONNECTIVE TISSUE.

PLATE VI.

CONNECTIVE TISSUE.

Photo-Micrographs.

Fig. 1. Huge connective-tissue cells, of fœtal rabbit; × 260. Logwood staining. While numerous quite large cells are scattered throughout the field, two are rendered conspicuous by their exceptional size. The processes of the branched corpuscle are in intimate relation to the flat cells seen beneath. Should portion of a process protrude between such cells, we can appreciate Klein's view regarding the nature of pseudo-stomata—stained processes of connective-tissue cells lying beneath.

Fig. 2. Lymph-spaces of dense connective-tissue, from the cornea, of calf; × 200. Deeply stained silver preparation. The spaces—in which the cells lie—are the light-colored, irregularly stellate areas, which, by their anastomosing branches, form a system of "juice-canals" throughout the tissue.

CONNECTIVE TISSUE.

Photo-Micrographs.

PLATE VII.

DENSE CONNECTIVE TISSUE.

Fig. 1. Adult tendon from the leg, of ox; × 280. Thin section treated with strong aniline solution. The tissue composed of nearly parallel bundles of compact white fibrous connective-tissue, between which are seen, in profile, the plate-like connective-tissue (tendon) cells, adherent to the bundles.

Fig. 2. Delicate tendon from the tail, of mouse; × 300. Gold preparation. The cells consist of two, or more, wings, which are applied to adjacent fibrous bundles. At *a*, the cells, with nucleus and quadrate wings, are seen in surface view. Across the cells, near the line of union of the wings, extends a very delicate fibre of elastic tissue, the latter being almost wanting in tendon. At *b*, several bundles are shown in section, with a cell (*w*) covering portion of the inter-fascicular space.

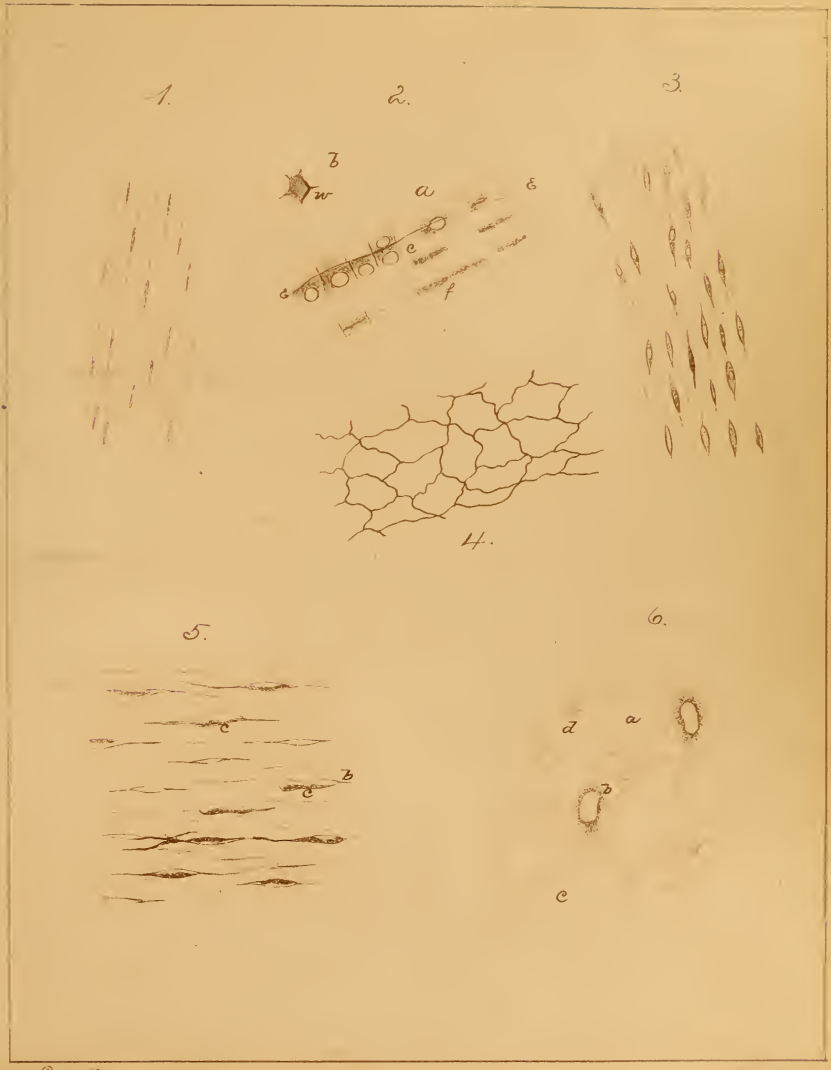
Fig. 3. Young growing tendon from leg, of kitten; × 300. The cells are active, numerous, and possess a relatively larger amount of protoplasm.

Fig. 4. A small tendon stained with silver, of mouse; × 275. The dark lines map-out the cells of the endothelial covering of the fibre.

Fig. 5. Section of the cornea, of frog; × 315. The lymph-spaces shown, in profile, between the lamellæ (*b*) of fibrous tissue; the cells (*c*) lie within.

Fig. 6. Similar tissue viewed from the surface. The spaces previously appearing as clefts, are seen to form a system of communicating, irregularly branched channels. At *b*, *d*, are remains of cells, which silver has distorted.

PLATE VII.



DENSE CONNECTIVE TISSUE.

PLATE VIII.

VARIETIES OF CARTILAGE.

Fig. 1. Hyaline cartilage from the sternum, of frog; × 200. *f*, the *perichondrium*, covering the free surface, and consisting of fibrous tissue compactly arranged externally, but forming a mesh-work, with lymph channels, towards the cartilage. *a*, the *matrix*—upon whose varying nature, the chief differences of the kinds of cartilage depend—is apparently homogeneous, really, probably, of closely cemented fibres. *d*, the cartilage (connective-tissue) cells lying within cavities in the matrix. The young cells, beneath the perichondrium, are arranged parallel to the free surface, and are separated by a small amount of the intercellular substance. The older cells, farther removed from the surface, are larger, and surrounded by more matrix. As usually seen, the protoplasm of the cells is shrunken and distorted.

Fig. 2. Embryonal cartilage from the head, of frog; × 200. The cells are closely grouped, and are actively engaged in division.

Fig. 3. Typical cartilage cell. Semi-diagramatic; × 525. The cell, with its prominent nucleus, fills, almost completely, the space in which it lies.

Fig. 4. Fibrous cartilage from an intervertebral disc, of mouse; × 300. *a*, the fibrous bundles, of which the matrix is evidently composed; along these, at varying intervals, are disposed the cells, *b*, each surrounded by a very limited area of homogeneous, hyaline substance.

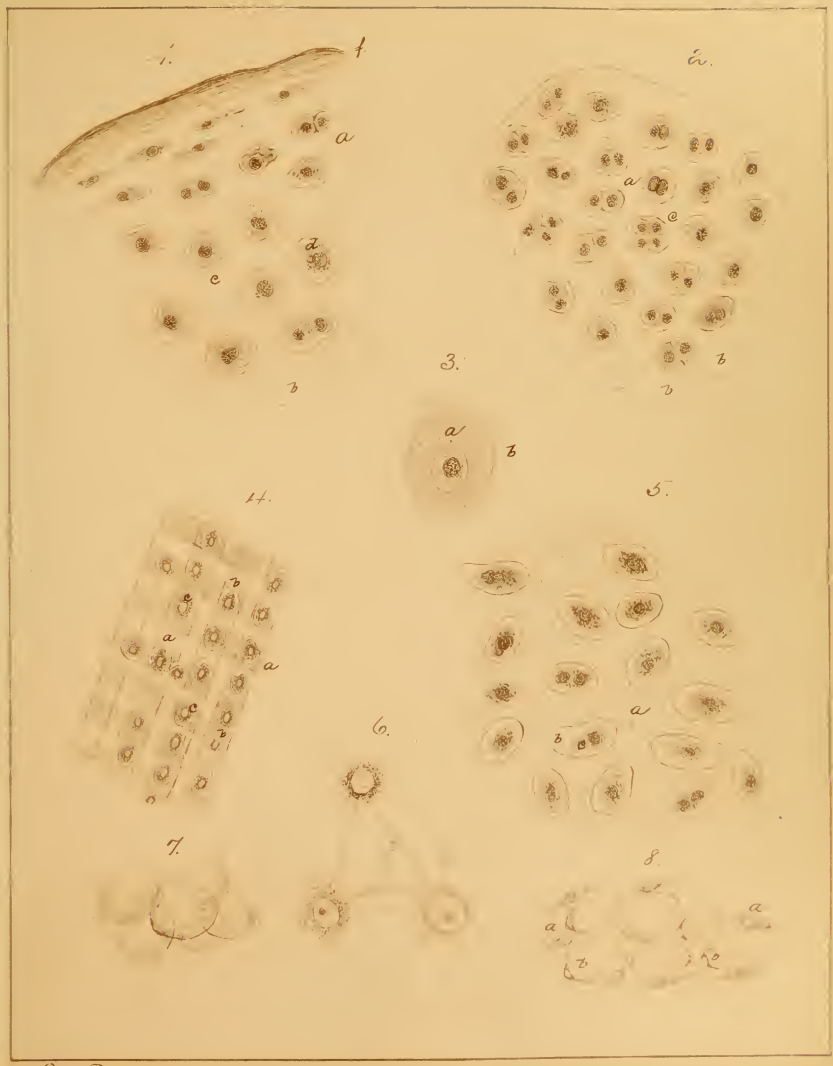
Fig. 5. Elastic cartilage from the ear, of man; × 375. *a*, the matrix, penetrated by numerous elastic fibres. Each cell is enclosed within a small tract, *b*, of hyaline substance.

Fig. 6. Cartilage cells, of newt; × 450. Cells are connected by delicate processes, extending through fine canals in the matrix. This arrangement exists, probably, in many instances where, ordinarily, it is invisible,

Fig. 7. Adipose tissue from omentum, of cat; × 350. As usually seen.

Fig. 8. Growing adipose tissue from the omentum, of rabbit; × 350. Many connective-tissue cells, *a*, beginning to contain oil drops within the protoplasm; that of those already "fat-cells" is almost completely replaced by fatty matters, the nucleus and remaining protoplasm being compressed into a small crescentic mass, *b*, to one side of the cell.

PLATE VIII.



G.H.P. Del.

VARIETIES OF CARTILAGE.

PLATE IX.

MATURE AND DEVELOPING BONE.

Fig. 1. Transverse section of a tarsal bone, giraffe; × 150. *a*, *Haversian canals* surrounded by the concentric *lamellæ* of the bone matrix—dense connective-tissue impregnated with calcareous salts. Each set constitutes a *Haversian system;* those lamellæ between, and not included in these, form the *interstitial systems.* Arranged between the lamellæ, are lenticular spaces, *b*, the *lacunæ;* from these radiate minute channels, *canaliculi.* These spaces, during life, are filled, more or less completely, by the connective-tissue cells—here called *bone-corpuscles.* The first three figures are from dried bone, where the spaces contain air, and, therefore, appear dark.

Fig. 2. Longitudinal section of a similar preparation; × 150. Haversian canals opened length-wise. The lamellæ now appear as parallel layers.

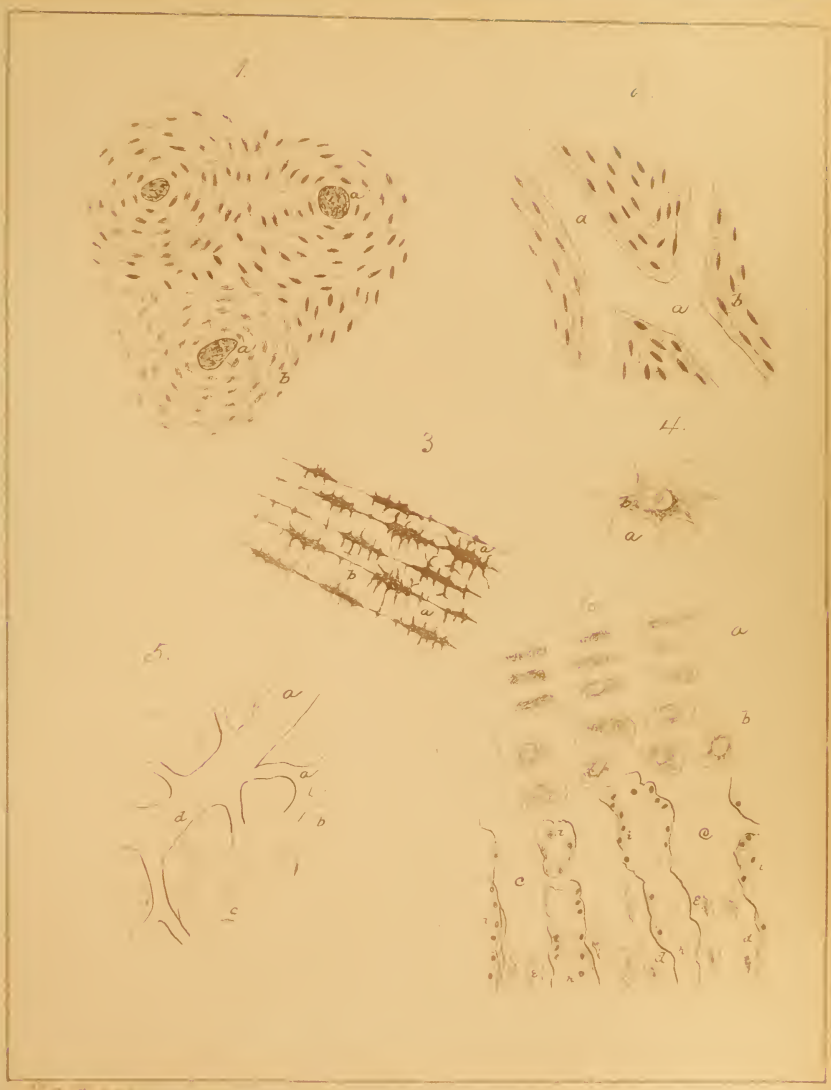
Fig. 3. Longitudinal section of femur, man; × 225. Higher amplification exhibits the canaliculi uniting adjacent lacunæ.

Fig. 4. A lacuna, with its bone-corpuscle, from a decalcified femur, dog; × 500. The nucleated cell fills almost completely its enclosing space.

Fig. 5. Yellow marrow from the femur, puppy; × 350. *a*, blood-vessels, containing a few red corpuscles, and surrounded by fat-cells.

Fig. 6. Development of bone from cartilage, tibia of fœtal lamb; × 350. *a*, the enlarged and flattened cartilage-cells, arranged in columns. *b*, zone of greatly dilated spaces, with distorted cells, the matrix becoming calcified. *c*, irregular trabeculæ of calcified cartilage, covered on the surface by *i*, the *osteoblasts.* Farther removed, these processes are gradually absorbed, becoming covered and replaced by deposits of true bone, *d*, in which are seen *e*, the primitive bone-corpuscles.

PLATE IX.



MATURE AND DEVELOPING BONE.

PLATE X.

DEVELOPMENT OF BONE.

Photo-Micrograph.

Fig. 1. Section of a carpal bone, fœtal lamb; × 35. Hæmatoxylin. The newly developed bone appears in the deeply colored, irregular trabeculæ, surrounded by the tissues of the medulla. Next to the processes of calcified cartilage, the lighter zones of dilated spaces may be appreciated; close inspection shows numerous cells arranged in columns. Several large canals for nutrition are exposed in section.

PLATE X.

DEVELOPMENT OF BONE.

Photo-Micrograph.

PLATE XI.

VARIETIES OF MUSCLE.

Photo-Micrographs.

Fig. 1. Transverse section of muscle, rabbit; × 65. Carmine. The larger groups, separated by the septa of connective-tissue, correspond to the *secondary* fibres, each of these being composed of smaller areas—*primary* fibres, which latter are made up of *ultimate fibrillæ*.

Fig. 2. Muscle fibres, ox; × 490. Fresh and teased. The upper fibre has been broken, displaying the *sarcolemma* bridging across the chasm in the muscular substance.

Fig. 3. A small fibre of voluntary muscle, man; × 1650. Hæmatoxylin. The high amplification exhibits conspicuously the alternate light and dark bands forming the striæ.

Fig. 4. Heart muscle, man; × 200. Hæmatoxylin. The characteristic branching of the fibres is seen near the centre of the field.

Fig. 5. Involuntary muscle, intestine of rabbit; × 150. Hæmatoxylin. Several of the delicate spindle cells are lying isolated.

PLATE XI.

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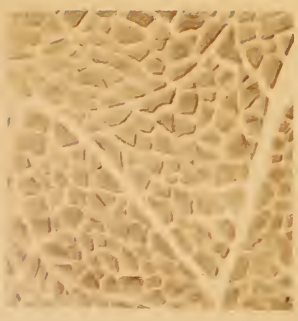


3.

5.

4.

VARIETIES OF MUSCLE.

Photo-Micrographs.

PLATE XII.

VARIETIES OF MUSCLE.

Photo-Micrographs.

Fig. 1. Voluntary muscle from the leg, frog; × 450. Alcohol and eosine. The alternate light and dark striæ are well displayed.

Fig. 2. Involuntary muscle from the mesentery, newt; × 160. Picro-carmine. A number of the large, extended muscle-cells are seen stretching across the field. It is to be noted, that the cell near the centre divides into two prongs at its upper extremity. The prominent nuclei contain the partially shrunken networks.

PLATE XII.

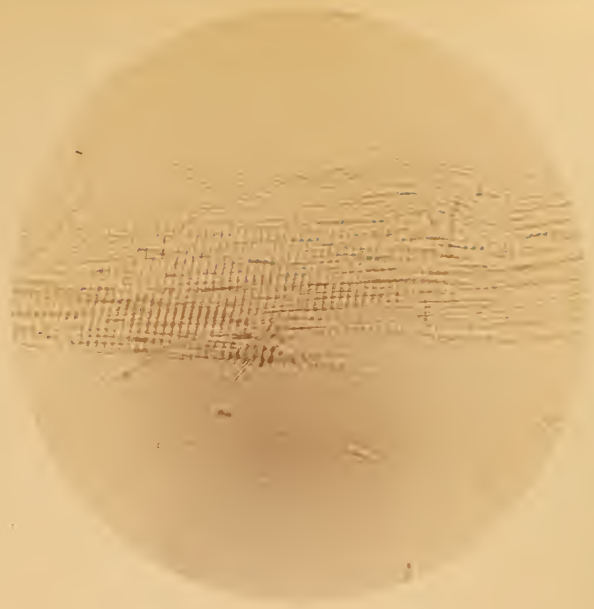


PLATE XIII.

NERVE FIBRES.

Fig. 1. Transverse section of a small nerve, ox; × 60. *a*, *epineurium*, the connective-tissue binding together the bundles of nerve fibres—funiculi, fat, blood-vessels, etc. *b*, *perineurium*, the sheath of the funiculus. *c*, nerve fibres seen in transverse section, appearing as nucleated cells; these are held in place by the *endoneurium*. *d*, adipose tissue.

Fig. 2. A funiculus from a similar preparation; × 180. *a*, *the perineurium*, composed of layers of fibrous tissue. *b*, nerve fibres in section, the axis-cylinders appearing as nuclei. *i*, cells of the delicate *endoneurium*. *p*, *m*, *t*, correspond to parts described, with same letters, under the next figure.

Fig. 3. Diagram of a medullated nerve. *a*, longitudinal, *b*, transverse view. *p*, *axis-cylinder*—composed of ultimate fibrillæ. *m*, *medullary sheath*, separated from the former by a minute lymph-space, *s*. *t*, *neurilemma*, investing the individual fibre. *n*, *nerve nucleus*. *r*, *node of Ranvier*, medulla wanting.

Fig. 4. As usually observed; × 450. Distortions from the post-mortem changes in the medullary substance. *a*, *b*, show irregular masses of myelin.

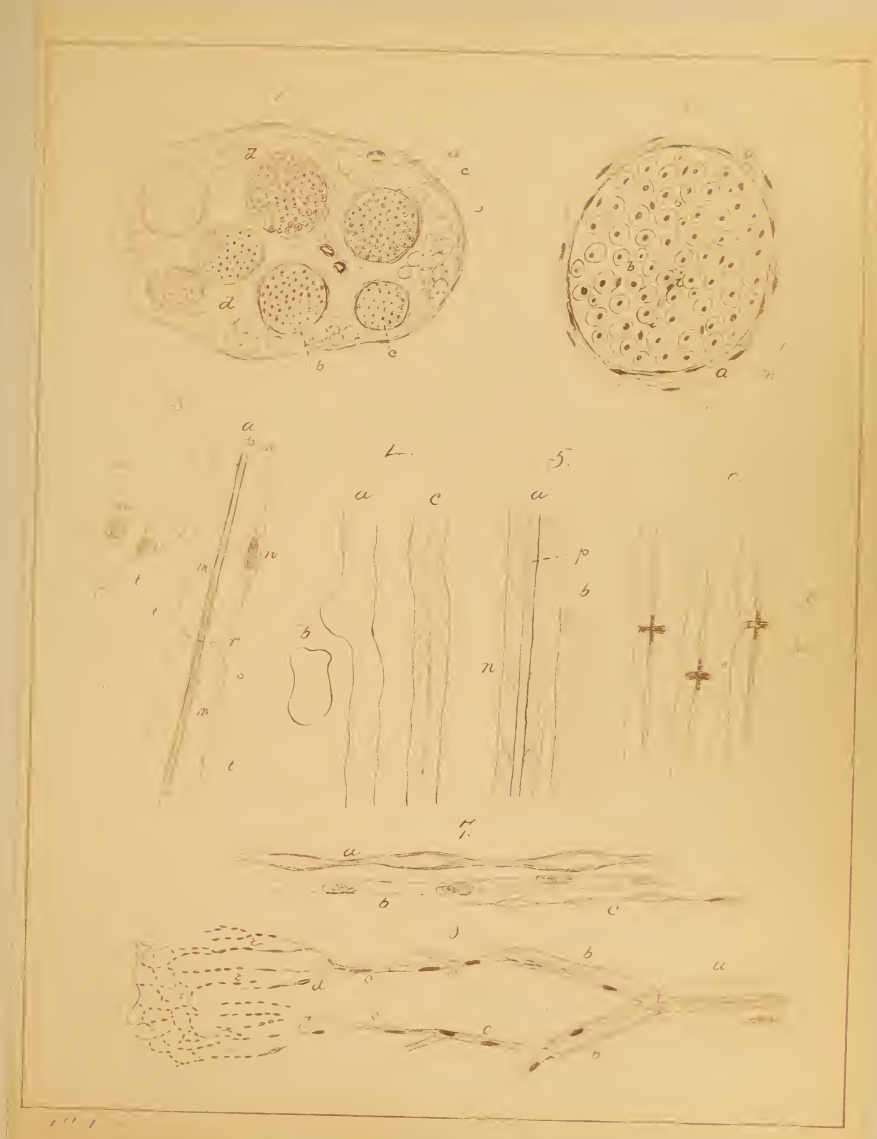
Fig. 5. Frog's nerve, after osmic acid; × 450. *a*, exhibits the segmented medullary sheath; *b*, reticulated appearance, depending upon minute vacuoles being present; these appearances are, probably, artificial productions.

Fig. 6. The same after silver staining; × 450. The solution penetrated at *c* to the axis-cylinder; this, with the stained transverse line, forms a cross.

Fig. 7. Diagram of *non-medullated* nerves. *a*, *c*, present varicosities; *b*, with numerous nuclei.

Fig. 8. Diagram illustrating the termination of medullated nerves. *a*. an ordinary medullated fibre, dividing into the smaller branches, *b:* at the succeeding bifurcation, the medullary sheath ceases, the fibres continuing as non-medullated, *c:* during such course, the neurilemma becomes attenuated until it disappears, and the axis-cylinder is clothed but with occasional nuclei. These become fewer, and the axis-cylinder thinner, until, finally, the latter is prolonged as a delicate, naked axis-cylinder, which presents frequently minute varicosities. Uniting with adjacent threads, they form the terminal plexus, in which so frequently the peripheral nerves have endings.

PLATE XIII.



NERVE FIBRES.

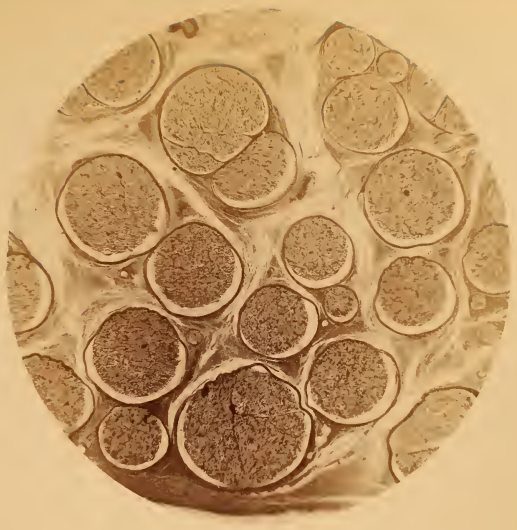
PLATE XIV.

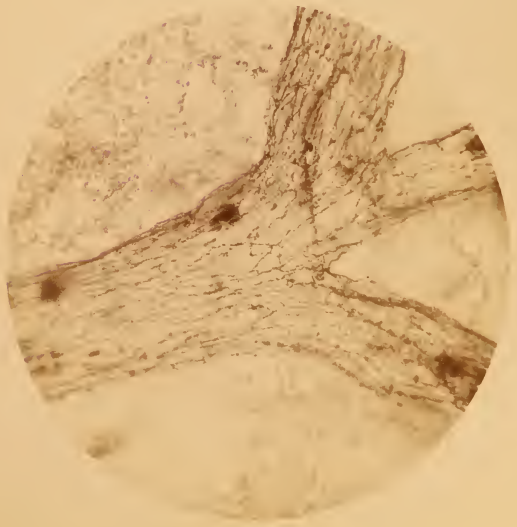
NERVE AND ARTERY.

Photo-Micrographs.

Fig. 1. Transverse section of a large nerve, ox; × 20. Hæmatoxylin staining. A number of funiculi, of varying diameter, seen in section; the cut ends of the nerve fibres appear as minute cells. The funiculi are loosely held together by the surrounding connective-tissue—the *epi-neurium;* each funiculus is enclosed in its proper sheath—the *peri-neurium*, while the nerve fibres are separated into secondary bundles, and held together, by the delicate *endo-neurium*, Blood-vessels, lymphatics, and fat abound in epineurium.

Fig. 2. Artery from the skin, frog; × 180. The vessels have been injected with silver solution, thereby staining the cement-substance, and outlining the endothelial plates of the intima.





NERVE AND ARTERY.

Photo-Micrographs.

PLATE XV.

BLOOD VESSELS.

Fig. 1. Transverse section of a medium sized artery, sheep; × 250. Hæmatoxylin. *a*, *intima*, the endothelium resting almost directly upon *i*, the corrugated *internal elastic* membrane. *b*, *media*, the muscle nuclei, *m*, distinctly seen; among these are the wavy bands, *s*, of elastic tissue. *c*, the fibro-elastic *adventitia*, separated from the media by the *external elastic* layer.

Fig. 2. Transverse section of a corresponding vein; × 250. Hæmatoxylin. The letters refer to the same parts as in the preceding figure.

Fig. 3. Small vessels from the submucosa, rabbit; × 225. Carmine. *a*, the artery; *b*, the vein, having thinner walls, and being occupied by a blood clot, in which several deeply stained leucocytes are seen.

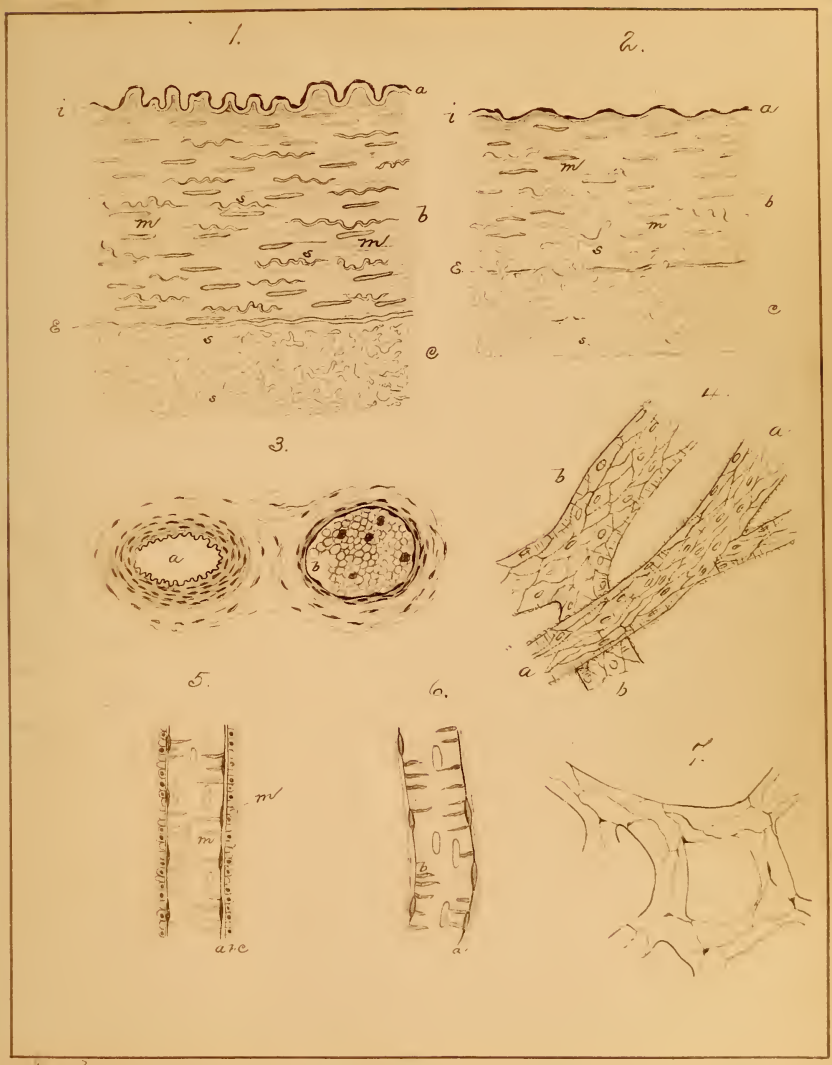
Fig. 4. Small vessels from the omentum, rabbit; × 230. Hæmatoxylin and silver. *a*, the artery; *b*, the vein. In both, the lining endothelium is brought to view, as are, also, the outlines of numerous muscle cells.

Fig. 5. Arteriole from the pia mater, man; × 300. Hæmatoxylin. While three coats are still present, they are reduced greatly in thickness, the muscular tunic, *b*, being represented by a single layer of cells.

Fig. 6. A similar vessel about to become a capillary. The muscle cells are grouped on alternate sides.

Fig. 7. Capillaries from the omentum, rabbit; × 300. Silver staining. The wall is here composed of the endothelial plates, the remaining coats having completely disappeared.

PLATE XV.



BLOOD VESSELS.

PLATE XVI.

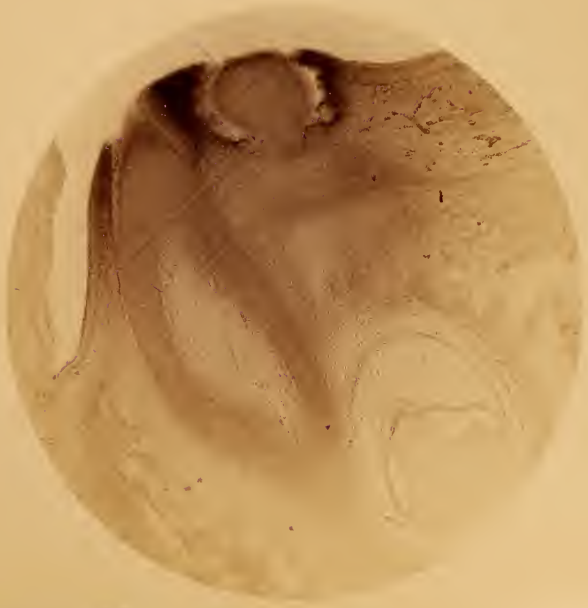
ADULT AND EMBRYONAL TEETH.

Photo-Micrographs.

Fig. 1. Section of jaw, cat; × 18. The central incisors shown fitted into their alveoli, and covered by the, here dark, periosteum. The pulp cavity is not seen. Each tooth is crowned by a capping of enamel. A very thin layer of cement invests the lower part of the fang.

Fig. 2. Section of jaw, kitten; × 25. Carmine staining. A milk-tooth is seen in oblique section, at the side of which, is the dental sac of a developing permanent tooth. The irregularly conical dental papilla is embraced by the tissues of the enamel organ.

PLATE XVI.



ADULT AND EMBRYONAL TEETH.

Photo-Micrographs.

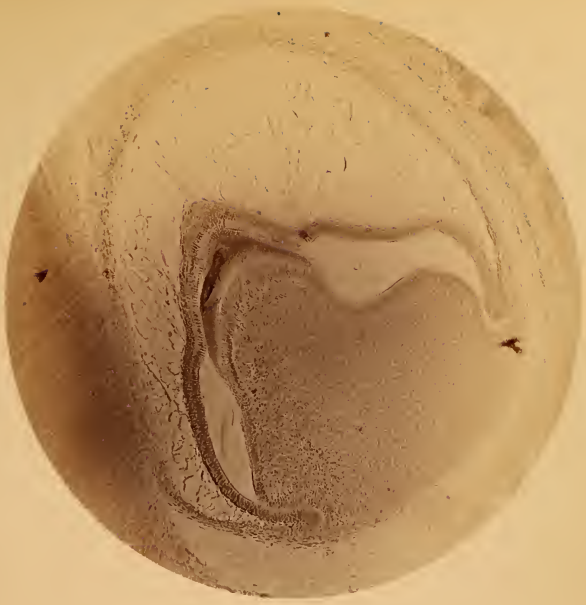
PLATE XVII.

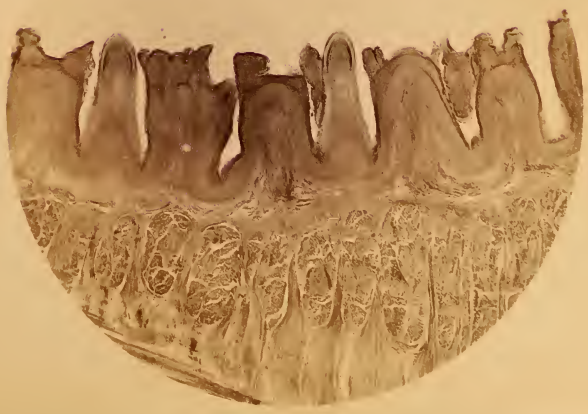
DEVELOPING TOOTH, AND TONGUE.

Photo-Micrographs.

Fig. 1. Section of jaw, kitten; × 70. Carmine staining. The field almost entirely occupied by the more highly magnified dental sac of the preceding figure. The sac is bounded by the wall derived from the surrounding connective-tissue, as is also the dental papilla. The latter protrudes towards the centre of the sac, covered by a layer of columnar cells—the *odontoblasts*. At the apex of the papilla, these cells are forming the dentine, covering the extreme summit of which, a thin layer of enamel is being deposited. The surface of the *enamel cap*, next to the papilla, possesses columnar cells; externally, is the extended mass of the honey-combed tissue of the middle layer, bounded by the epithelium of the outer.

Fig. 2. Transverse section of tongue, cat; × 20. Double staining. The mucosa thrown into prominent folds covered by squamous epithelium—the *papillæ*. Of these, two forms are seen—the simple conical, and the compound or fungiform. The muscles are shown, cut in two directions.





DEVELOPING TOOTH, AND TONGUE.

Photo-Micrographs.

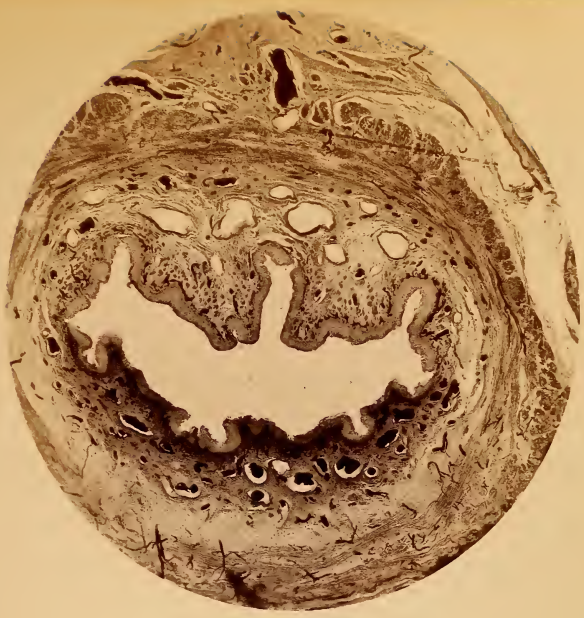
PLATE XVIII.

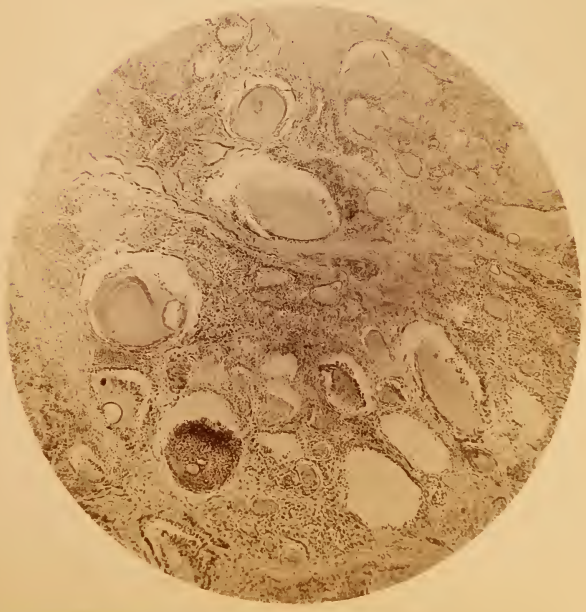
ŒSOPHAGUS AND THYROID BODY.

Photo-Micrographs.

Fig. 1. Section of the œsophagus, child; × 15. Carmine staining. The mucous membrane is thrown into longitudinal folds when relaxed, which are here cut transversely, the free surface being covered with a stratified squamous epithelium. Beneath the mucosa, is the loose connective-tissue of the submucosa, here seen to contain numerous blood-vessels. The layers of the muscular tunic are but imperfectly exhibited.

Fig. 2. Transverse section of the thyroid body, man; × 65. Carmine staining. A number of alveoli are laid open; these vary in size, and in the quantity of their contents, the latter being, usually, a yellowish, viscid, albuminous mass. The alveoli are lined by low columnar epithelium, and are separated and surrounded by a stroma of connective-tissue.





ŒSOPHAGUS AND THYROID BODY.

Photo-Micrographs.

PLATE XIX.

THE STOMACH.

Fig. 1. Section of the stomach, central region, man; × 20. Carmine. *a*, *mucosa*, containing the simple tubular, *peptic* glands. *b*, *muscularis mucosæ*, the delicate layer of involuntary muscle. *c*, *submucosa*, in which are found the larger blood-vessels, nerves, and lymphatics. *d*, *e*, *muscular tunic*—the former extending transversely, the latter longitudinally; the imperfect oblique layer is absent. Covering the free surface, is the *serous* coat.

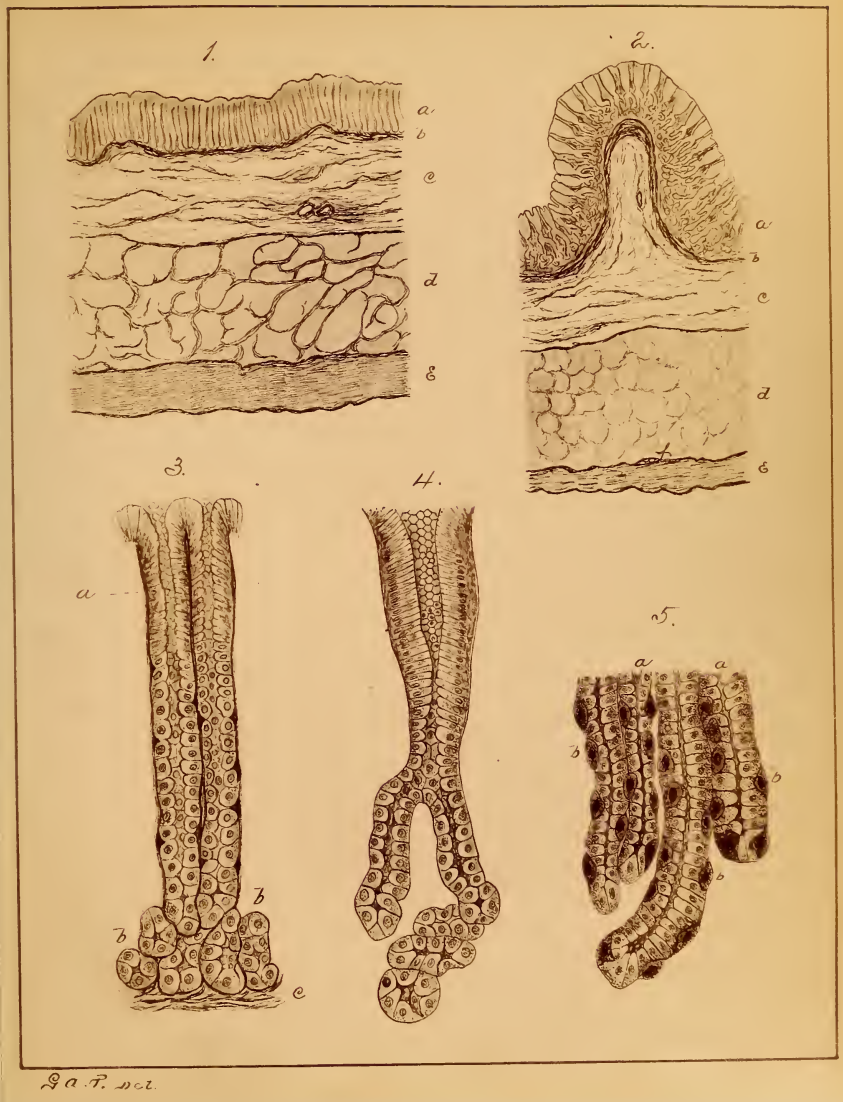
Fig. 2. Section of the same, near the pyloric extremity; × 20. Carmine. The mucosa is thrown into folds, and contains the compound tubular, *pyloric* glands. The reference letters correspond to those preceding.

Fig. 3. Peptic glands, central region, dog; × 160. Carmine. *a*, the *duct*, lined with the slightly modified columnar cells of the adjacent mucous-membrane. *b*, the *fundus*, the wavy glands being cut in different planes. *c*, the tissue of the muscularis mucosæ.

Fig. 4. Pyloric gland, dog; × 160. Hæmatoxylin. The duct is proportionately longer, and divides, at the neck, into the wavy extremities.

Fig. 5. The terminations of several peptic glands, dog; × 250. Double staining. The cells are of two kinds—the ordinary glandular epithelium, or *chief cells*, and those deeply stained, situated peripherally, the *parietal cells*.

PLATE XIX.



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THE STOMACH.

PLATE XX.

THE STOMACH AND GLANDS.

Fig. 1. Horizontal section of the mucous membrane of the stomach, dog; × 160. Carmine. The section has passed in the plane of the ducts, *a*, of the glands, a number of which, varying in size, are seen. *b*, the surrounding connective-tissue of the mucous membrane.

Fig. 2. Similar section, passing through the plane of the extremities of the same glands. *a*, the tubular glands arranged in groups, separated from neighboring groups by *b*, the connective-tissue septa. *c*, adenoid tissue.

Fig. 3. Section of the pancreas, dog; × 200. Hæmatoxylin. The somewhat tubular acini or alveoli cut in various directions, lined with secreting cells, *a*, and limited by the basement membrane. *b*, duct in section, with columnar epithelium. *c*, inter-alveolar connective-tissue. *d*, one of the masses of the peculiar *inter-alveolar cells*.

Fig. 4. Section of the submaxillary gland, rabbit; × 200. Hæmatoxylin. *a*, sections of the acini, of which this racemose gland is composed, lined with the secreting cells. *b*, a branching duct, with striated columnar epithelium. *c*, the supporting connective-tissue.

PLATE XX.

THE STOMACH AND GLANDS.

PLATE XXI.

STOMACH AND INTESTINE.

Photo-Micrographs.

Fig. 1. Section of injected stomach, cat; × 15. The longitudinal folds of the mucous membrane here seen in transverse section. The vascular supply of the mucosa beautifully injected, appearing as networks of dark lines; the larger branches are seen in the submucosa.

Fig. 2. Transverse section of the small intestine, kitten; × 20. The coats of the intestinal wall are shown, with a partial injection of the blood vessels. The long, delicate forms of the villi are to be noted.

PLATE XXI.

STOMACH AND INTESTINE.

Photo-Micrographs.

PLATE XXII.

THE INTESTINES.

Fig. 1. Transverse section of the small intestine, cat; 35. Carmine. *a*, *mucosa*, comprising *v*, the *villi*, and *g*, the *simple tubular glands*—follicles of Lieberkühn. *b*, *submucosa*, separated from the mucosa by the delicate *muscularis mucosæ*. *c–d*, *muscularis*—composed of the inner, circular, and the outer, longitudinal fibres. *h*, ganglion cells of the *plexus of Auerbach*.

Fig. 2. Transverse section of the large intestine, cat; × 35. Carmine. The tubular glands of the mucosa are distinguished by the large number of "*goblet cells*." The letters refer as in preceding figure.

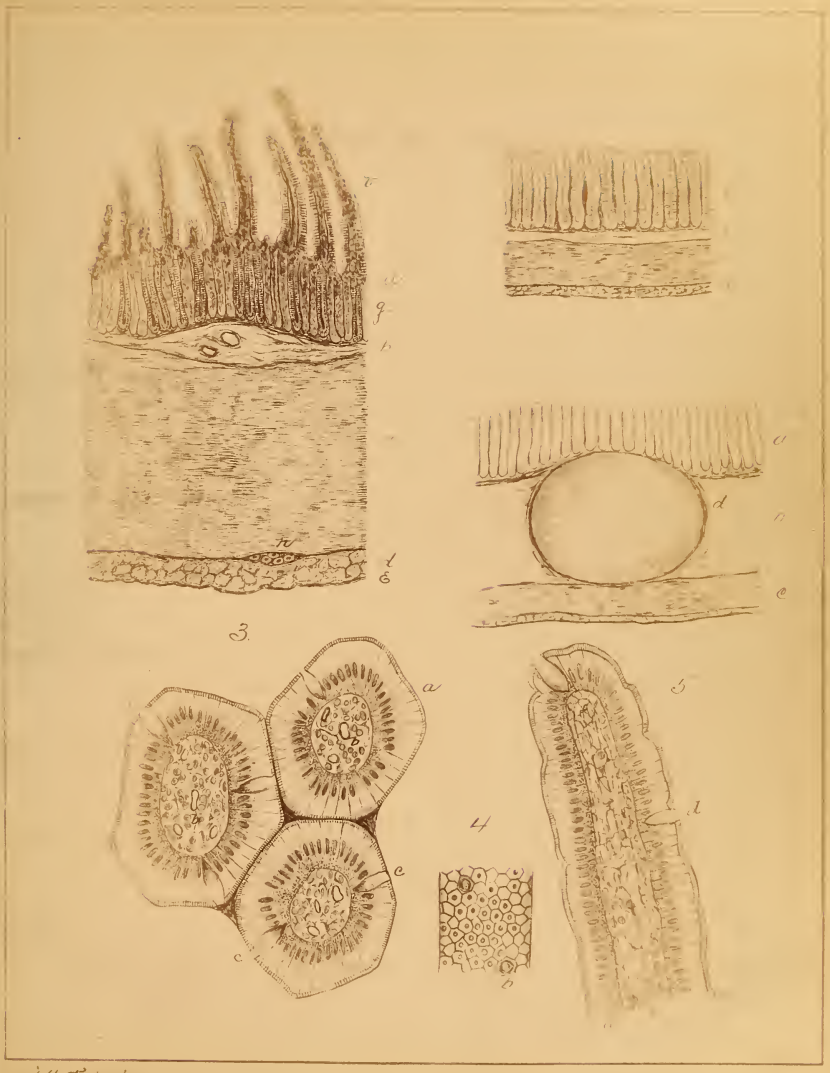
Fig. 3. Horizontal section of the mucosa of small intestine, kitten; × 200. Osmic acid. The section has passed through the villi at their bases; by mutual pressure their exteriors have become polygonal. *a*, the columnar epithelium, with striated border. *c*, goblet cells. *b*, core of the villi, composed of adenoid tissue, supporting the central *lacteal* and blood-vessels, and separated from the epithelium by the delicate basement membrane.

Fig. 4. Surface view of the epithelium of a villus, kitten; × 200. Carmine. The columnar cells seen end-wise appear as small polygonal areas. *b*, end-view of goblet cells.

Fig. 5. Longitudinal section of a villus, kitten; × 200. Carmine. *a*, the columnar epithelium, with striated border. *b*, the core.

Fig. 6. Large intestine, man; × 35. Carmine. At *d*, a mass of adenoid tissue—*solitary gland*—is seen, occupying the submucosa, and encroaching upon the mucosa; frequently, such structures project into the tube.

PLATE XXII.



THE INTESTINES.

PLATE XXIII.

THE LIVER.

Fig. 1. Section of the liver, parallel to the surface, pig; × 28. Carmine. *a*, hepatic vein—*intra-lobular* vessel. *b*, one of the *inter-lobular* vessels, embedded in the, here generously developed, inter-lobular connective-tissue.

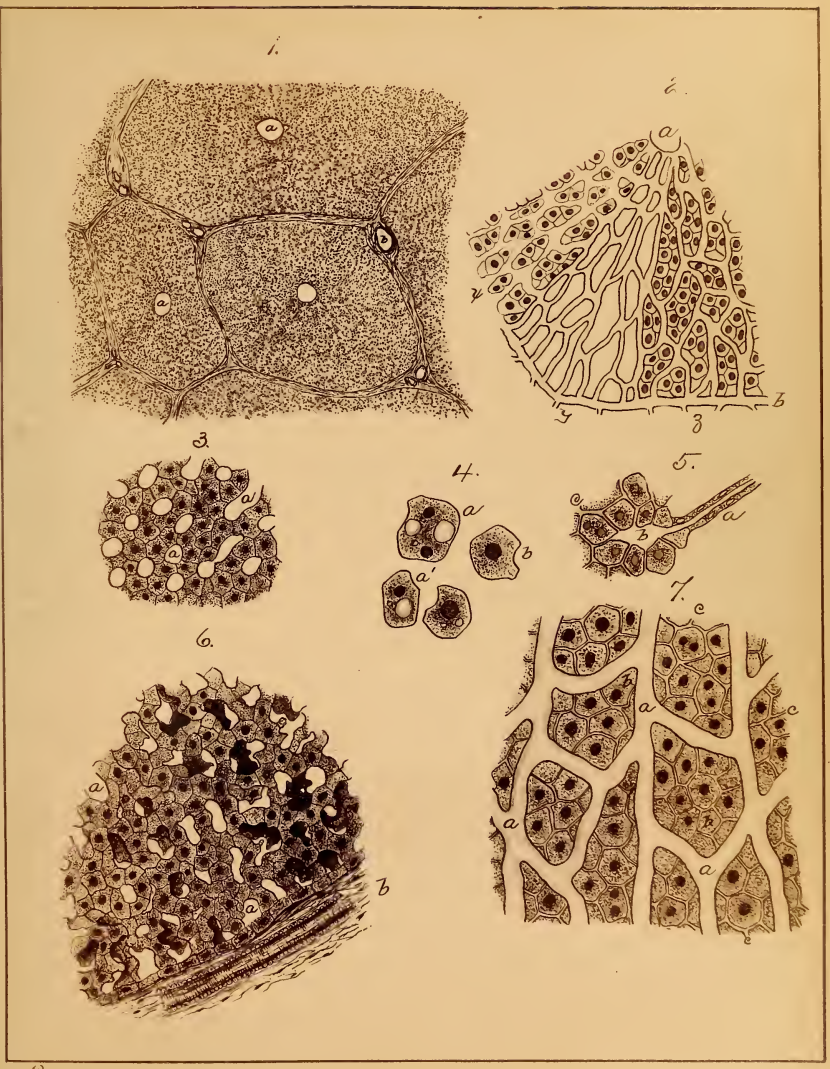
Fig. 2. Diagram of a hepatic lobule. *a*, hepatic vein; *b*, portal vein, the two communicating by the radiating capillary network, in whose meshes are situated the *liver-cells*. The tract *y* shows but the vascular network. *x*, that formed by the cords of cells, the vessels being the clefts. *z*, where both vessels and cells are seen in their mutual relations.

Figs. 3, 6. Sections of the liver, man; × 175. Carmine. Fig. 6 cut parallel; Fig. 3, vertical to the surface of the organ. *a*, sections of the vessels of the capillary network. *b*, a larger branch of the portal vein, surrounded by the inter-lobular connective-tissue.

Fig. 5. Exhibits the mode of origin of the *bile-ducts* at the periphery of a lobule. Semi-diagramatic. *a*, the duct, formed by the union of *b–c*, the inter-cellular clefts.

Fig. 7. Illustrating the relation between the cells and the *bile-canaliculi*. Semi-diagramatic. *a*, the blood-vessels. *b*, the hepatic cells, surrounded by *c*, the close network of biliary canaliculi.

PLATE XXIII.



Pl. XXIII.

THE LIVER.

PLATE XXIV.

DIAGRAM OF THE KIDNEY.

Fig. 1. The distribution of the vascular supply, with the course of the uriniferous tubules shown. *C*, Cortex; *B*, Boundary layer; *P*, Papillary zone—the last two together forming the Medulla. *a*, artery breaking into two sets of vessels—those running towards the periphery, and those passing into the medulla. *b*, corresponding vein. *g*, the terminal masses of convoluted capillary loops—the *Malpighian tufts* or *glomeruli*. *i*, venous network. *d*, vessels surrounding the papillary ducts. *m*, Malpighian *body* or *corpuscle*—composed of vascular tuft and enveloping capsule. The latter, *capsule of Bowman*, is the dilated blind-extremity of a uriniferous tubule, whose tortuous course—with many changes in caliber and in the character of the lining epithelium—is, briefly, as follows: 1, dilated *capsule*, enclosing the tuft, and presenting a constricted *neck;* 2, *proximal convoluted* tube; 3, *spiral* portion; 4–8, descending and ascending limbs of the *loop of Henle;* 9, *irregular* portion; 10, *distal convoluted* tube; 11, *arched collecting* tube; 12, *straight collecting* tube; by the union of such tubes, the large *papillary duct*, 14, is formed, opening, at 15, upon the free surface of a papilla.

Fig. 2. Diagram of a Malpighian body. *a*, *afferent* vessel, breaking-up into the convoluted loops, and passing out as *e*, the *efferent* vessel. *c*, the *capsule*. *d*, the flat, endothelioid *epithelium* covering the tuft, and lining the capsule, being continuous with the epithelium of the tubule; the lower half of the capsule presents these cells in surface-view.

Figs. 3–6. Exhibiting, respectively, the "rod," flat, and columnar cells lining different parts of the tubules—all parts, from the neck to the arched collecting tube, possess the striated columnar or rod epithelium, the descending limb of Henle's loop excepted; the latter is lined by delicate flat cells: the collecting tubes retain their columnar epithelium throughout.

PLATE XXIV.

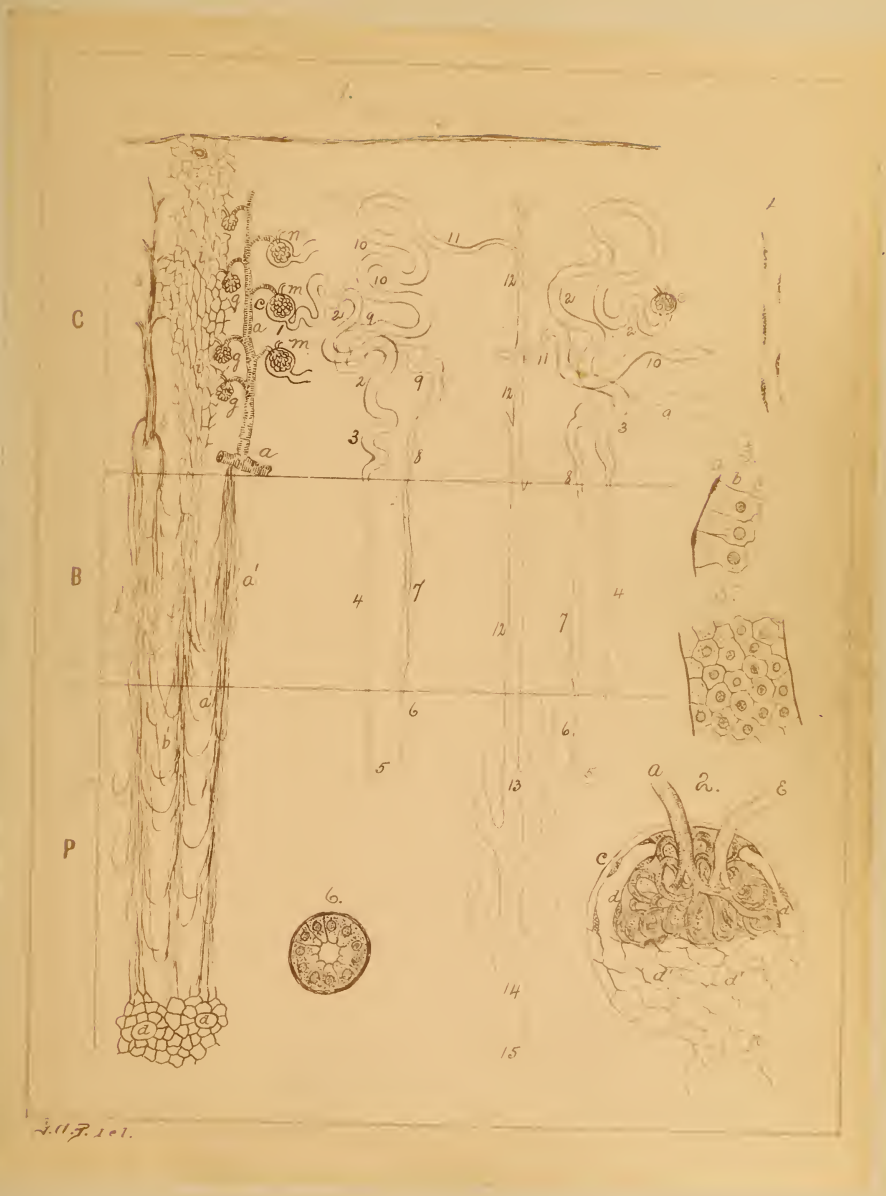


DIAGRAM OF THE KIDNEY.

PLATE XXV.

THE KIDNEY.

Fig. 1. Radial section of the kidney, rabbit; × 160. Hæmatoxylin. (All figures of this plate are from sections of one kidney, stained alike, and magnified the same.) The left portion of the figure is the labyrinth; the remainder is part of a medullary ray. *a*, Malpighian tuft, surrounded by its capsule; the cells lining the latter are seen in profile. *b*, convoluted tubules cut in various directions. *f*, section of irregular portion. *m*, spiral tubes. *n*, straight collecting tubes. *o*, ascending limb of Henle's loop.

Fig. 2. Portion of the papillary zone of the same section. *a*, collecting tubes. *b*, blood-vessels. *c*, inter-tubular connective-tissue.

Fig. 3. Horizontal section of the same.

Fig. 4. Tangential section. *a*, Malpighian bodies. *b*, surrounding tubules cut in various directions; the tubes in the centre belong to a medullary ray, seen in transverse section.

Fig. 5. Section through the base of a papilla. *a*, large ducts, lined with the beautiful columnar cells. *b*, blood-vessels. *c*, connective-tissue.

PLATE XXV.

THE KIDNEY.

PLATE XXVI.

KIDNEY AND PROSTATE GLAND.

Photo-Micrographs.

Fig. 1. Radial section of injected kidney, cat; × 15. Carmine-gelatine mass. Cortex and the greater part of medulla in the field. On either side, the circular openings are the canals, through which the principal vessels gain entrance. Throughout the cortex, the Malpighian tufts appear as the dark spots, surrounded by the convoluted tubules of the labyrinth.

Fig. 2. Section of the prostate gland, monkey; × 65. Carmine staining. Numerous tubular alveoli, lined by columnar cells, cut in various directions. The surrounding stroma is composed largely of involuntary muscle.

KIDNEY AND PROSTATE GLAND.

Photo-Micrographs.

PLATE XXVII.

MALE REPRODUCTIVE ORGANS.

Fig. 1. Section of the testicle, dog; × 40. Carmine. *a*, section of the fibrous capsule—*tunica albuginea*. *b*, the *seminiferous tubules*, cut in varying directions, and lined with the epithelial cells, whose deeply stained nuclei are nearly all engaged in some stage of division.

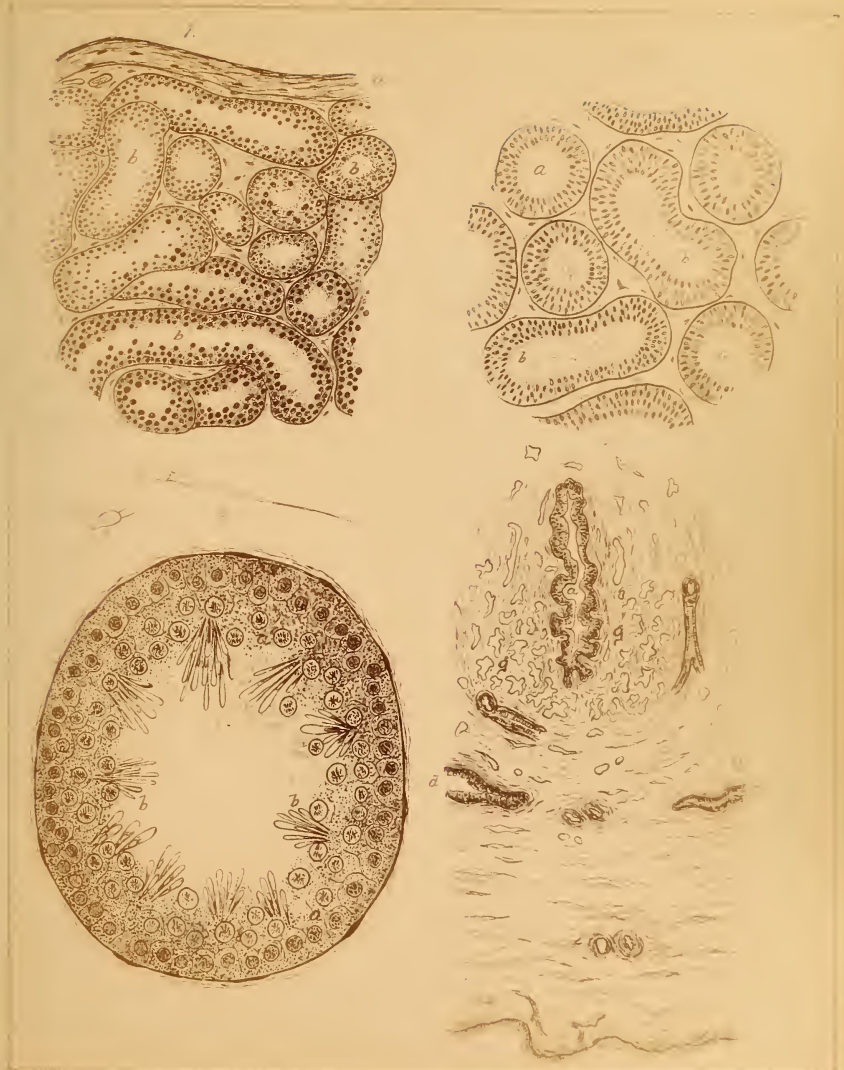
Fig. 2. Section of the epididymis, dog; × 40. Carmine. *a*, sections of the tube, lined with ciliated columnar cells. *b*, masses of *spermatozoa*.

Fig. 3. Transverse section of a seminiferous tubule, musk-rat; × 270. Hæmatoxylin. The layers next to the basement membrane contain many cells in active division, whose prominent nuclei exhibit different stages of karyokinesis. *b*, groups of the developing spermatozoa—the heads being derived from the nuclei of the *spermatoblasts;* the tails being from the protoplasm of these cells.

Fig. 4. Section of the penis, child, × 15. Carmine. *a*, *urethra*, lined with columnar epithelium, and surrounded by the cavernous tissue of the *corpus spongiosum*. *b*, skin. *d*, reflections of the mucous membrane.

Fig. 5. Spermatozoa, man; × 800. *a*, front view; *b*, profile.

PLATE XXVII.



MALE REPRODUCTIVE ORGANS.

PLATE XXVIII.

FEMALE REPRODUCTIVE ORGANS.

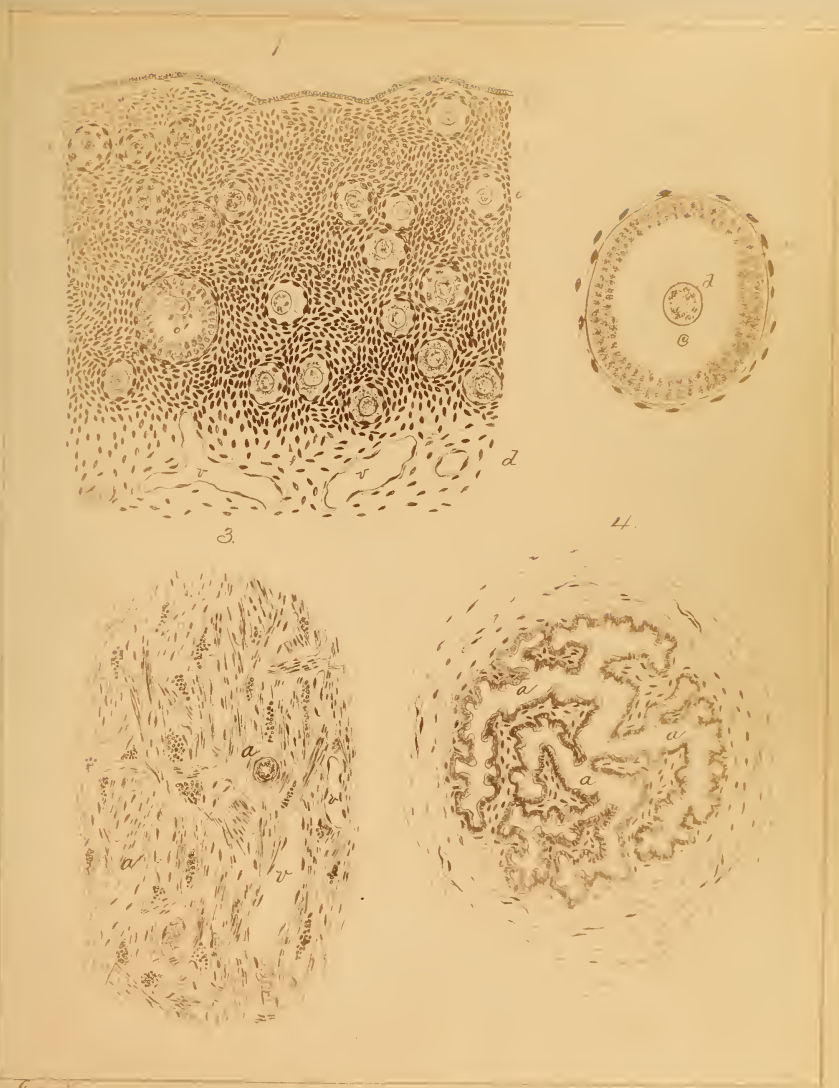
Fig. 1. Section of the ovary, child; × 165. Carmine. *a*, the layer of the *germinal epithelium* covering the free surface. *b*, zone of condensed stroma without ova—the *tunica albuginea; c*, the stroma of the *cortex* composed of the abundant spindle cells with prominent nuclei. *d*, the connective-tissue. *v*, blood-vessels in section. *o*, *Graafian follicles*, in course of development.

Fig. 2. A Graafian follicle from the same preparation; × 170. The increased dimensions of the follicle are due to development, not to higher amplification. *a*, *theca* or limiting membrane, covered with the cells of the *membrana granulosa*. *b*, coagulated, granular mass, probably derived from the *liquor folliculi*. *d*, the *ovum*.

Fig. 3. Section of the uterus, woman; × 35. Carmine. Numerous bundles of involuntary muscle cut in various directions; the nuclei are deeply stained. *a*, artery. *v*, venous inter-fascicular blood-channels.

Fig. 4. Transverse section of the Fallopian tube, child; × 35. Carmine. The mucous membrane is rich in longitudinal folds, which are here cut transversely, producing the apparent elaborate papillary structures, *a*, which encroach upon the lumen of the tube. The mucous membrane is invested with ciliated columnar cells.

PLATE XXVIII.



FEMALE REPRODUCTIVE ORGANS.

PLATE XXIX.

FEMALE GENERATIVE ORGANS.

Photo-Micrographs.

Fig. 1. Transverse section of ovary, cat; × 70. Beneath the surface of the organ, a zone rich in ova is seen. One of the Graafian follicles has advanced well towards maturity, showing the ovum held in position by a fork of coagulated liquor folliculi. The ovum is surrounded by the cells of the discus proligerus. A few injected vessels appear as dark lines.

Fig. 2. Section of ovary, cat; × 225. A well developed Graafian follicle occupies nearly the entire field. The limiting *membrana propria* is lined by a mass of cells, the *membrana granulosa*. The ovum itself, surrounded by the *discus proligerus*, displays a distinct cell-wall—*zona pellucida*, nucleus—*germinal vesicle*, and nucleolus—*germinal spot*. The *liquor folliculi* occupies the space between the membrana granulosa and the discus proligerus.

PLATE XXIX.

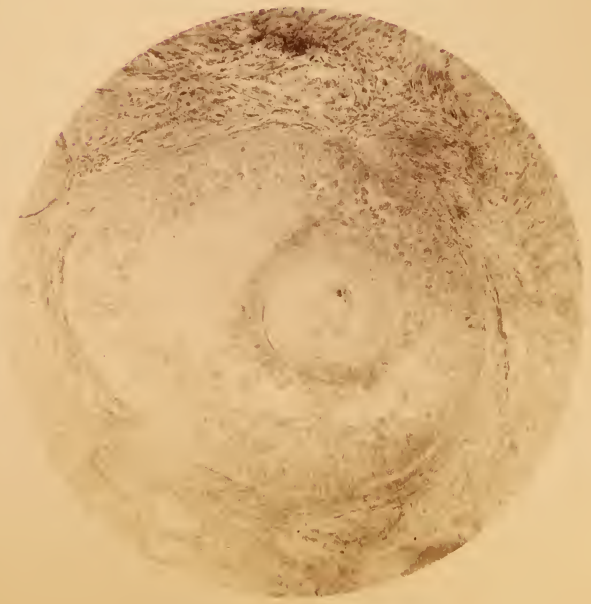


PLATE XXX.

THE SPINAL CORD.

Fig. 1. Transverse section of the spinal cord, cat; × 15. Carmine. *w*, *white* matter; *g*, *gray* matter—*ah*, *ph*, respectively, anterior and posterior *horns* of the same. *b*, *anterior median* fissure; *c*, *posterior median* fissure. *a* the anterior, *p* the posterior *roots* of the spinal nerves. *x*, *central canal.*

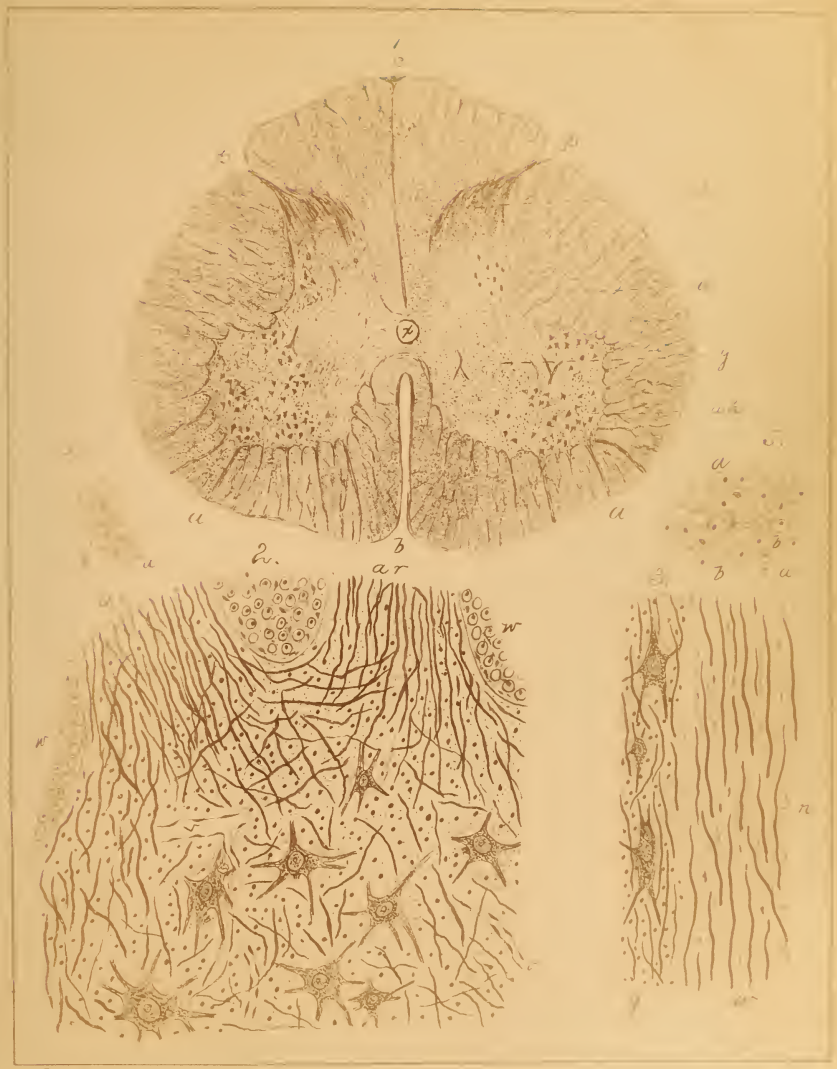
Fig. 2. Section of portion of the anterior horn of gray matter, calf; × 100. Hæmatoxylin. *w*, white matter, composed largely of nerve-fibres supported by *neuroglia*; the fibres appear in section as small nucleated cells. *ar*, bundles of nerve-fibres of the anterior roots, arising from the gray matter. Many deeply stained axis-cylinders are seen throughout the section. The large *multipolar ganglion* cells—lying within lymph-spaces—are rendered conspicuous by their processes. *v*, blood-vessels.

Fig. 3. Longitudinal section of the same cord; × 100. Hæmatoxylin. *w*, white, *g*, gray matter; nerve-fibres, together with the nerve-cells, seen in longitudinal section.

Fig. 4. Columnar epithelial cells lining the central canal, calf; × 170. Hæmatoxylin. *a*, free-ends—ciliated in very young animals; *b*, modified neuroglia, into which the cells, apparently, send processes.

Fig. 5. Portion of the white matter; × 170. Carmine. *a*, nerve-fibres in section; *b*, supporting neuroglia, containing minute stellate cells.

PLATE XXX.



THE SPINAL CORD.

PLATE XXXI.

THE BRAIN.

Fig. 1. Section of the gray matter of the cerebral cortex, man; × 150. Carmine. The figure represents Meynert's *third layer*—rich in pyramidal nerve-cells, *b*, lying within minute lymph-spaces. *a*, supporting neuroglia. *c*, small nerve-cells. *n*, sections of bundles of nerve-fibres. *v*, blood-vessels, surrounded by their perivascular sheaths.

Fig. 2. Section of pons Varolii, man; × 150. Carmine. *a*, neuroglia. *b*, *d*, large and small nerve-cells. *n*, tracts of nerve-fibres.

Fig. 3. Section of cerebellum, man; × 150. Hæmatoxylin. *a*, *outer layer*, composed of numerous branching processes of the ganglion cells, small cells, blood-vessels, and neuroglia. *b*, *granule layer*, containing closely placed nuclei, surrounded by a very meager amount of protoplasm. On the external border of the granule layer are distributed the *corpuscles of Purkinji*, *p*, with richly branched, antler-like processes.

Fig. 4. Section of injected cerebellum, man; × 35. Carmine-gelatine. *a*, *b*, outer and granule layers; *c*, white matter.

PLATE XXXI.

THE BRAIN:- Cerebrum and Cerebellum.

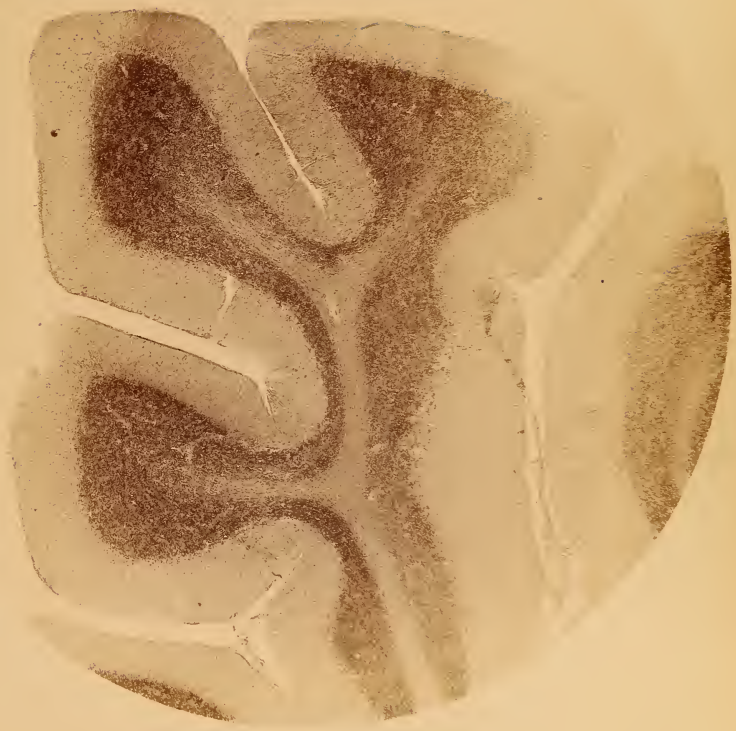
PLATE XXXII.

BRAIN:— CEREBELLUM.

Photo-Micrograph.

Fig. 1. Transverse section of cerebellum, man; × 20. Several secondary laminæ shown in section; in these, the three layers are very evident. Next to the branching, white *medullary centre*, lies the well marked, and deeply stained, *granule layer;* external to this, extends the *outer layer*. Between these layers, an imperfect zone of large ganglionic cells—*corpuscles of Purkinje*—will be seen on close examination.

PLATE XXXII.



THE BRAIN:- Cerebellum.

Photo-Micrograph.

PLATE XXXIII.

LYMPHATIC TISSUES AND VESSELS.

Fig. 1. Lymph-clefts between the connective-tissue bundles, skin of dog; × 200. Hæmatoxylin. *a*, spaces imperfectly lined with endothelioid cells.

Fig. 2. Diffuse lymphatic or adenoid tissue, mucosa of dog's stomach; × 160. Carmine. *a*, extremities of the peptic glands.

Fig. 3. Circumscribed nodule of adenoid tissue, dog; × 70. Carmine.

Fig. 4. Perivascular lymphatic vessel, mesentery of frog; × 50. Silver. *a*, the capillary surrounded by the ensheathing lymphatic.

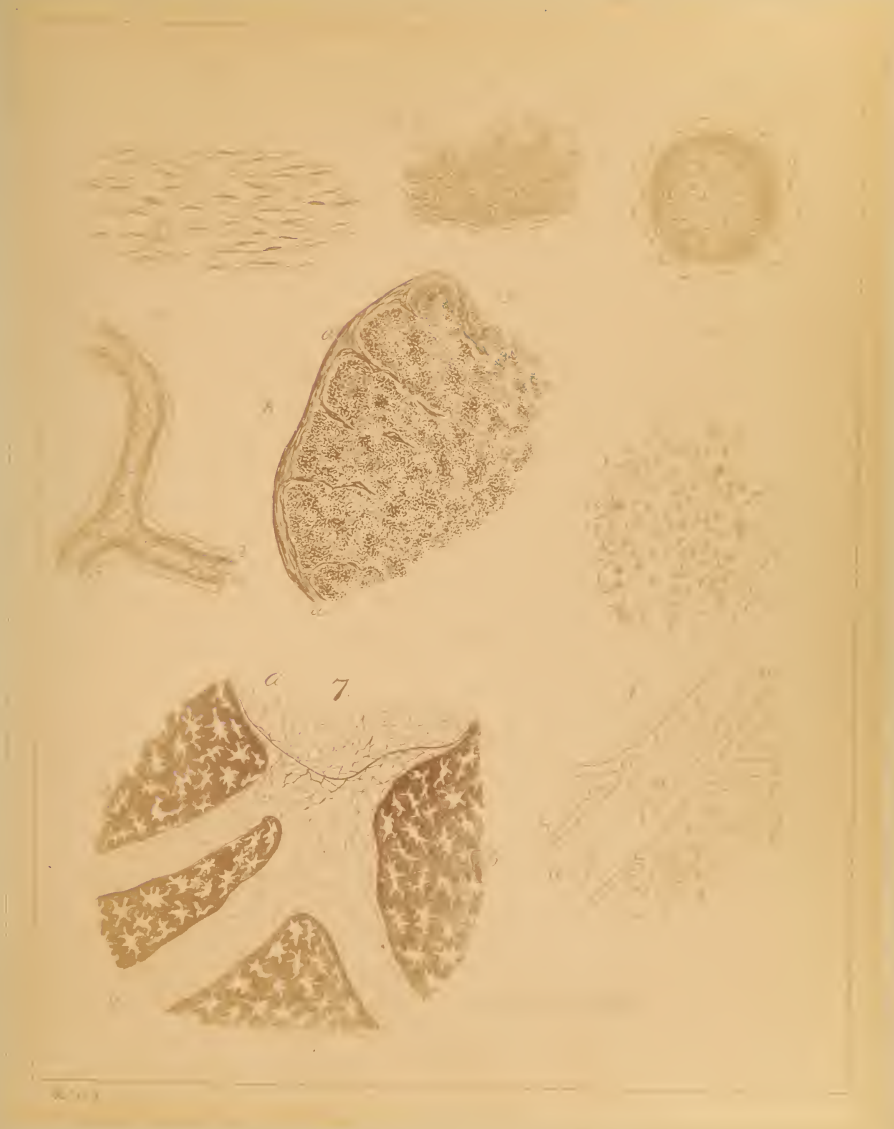
Fig. 5. Section of a lymphatic gland, rabbit; × 35. Hæmatoxylin. *a*, *capsule*, sending off *trabeculæ*. *b*, dividing the cortex into incomplete compartments. These are occupied by a central mass of dense adenoid tissue—*cortical follicles*, separated from the capsule and its processes by spaces containing a much looser tissue—*lymph sinuses*, through which the lymph circulates. In the medulla, the cortical follicles are continued as the anastomosing *medullary cylinders*.

Fig. 6. Adenoid tissue, from the preceding gland; × 200. Composed of two elements: the delicate reticulum of connective-tissue, *b*, with the occasional stellate cells, *a*, and the lymphoid cells, *d*, lying within the meshes of the former.

Fig. 7. Lymphatic vessels, diaphragm of rabbit; × 35. Silver. *a*, vessel dividing into smaller branches, and exhibiting a valve in profile. The lining cells are distinctly seen. *b*, adjacent tissue, with the lymph-channels.

Fig. 8. Lymphatic tract, surrounding larger corneal nerves, kitten; × *a*, lymphatic, imperfectly lined with endothelial cells; *b*, spaces of the surrounding tissue, communicating, at *c*, with the lymphatic channel.

PLATE XXXIII.



LYMPHATIC TISSUES AND VESSELS.

PLATE XXXIV.

LYMPHATIC GLANDS.

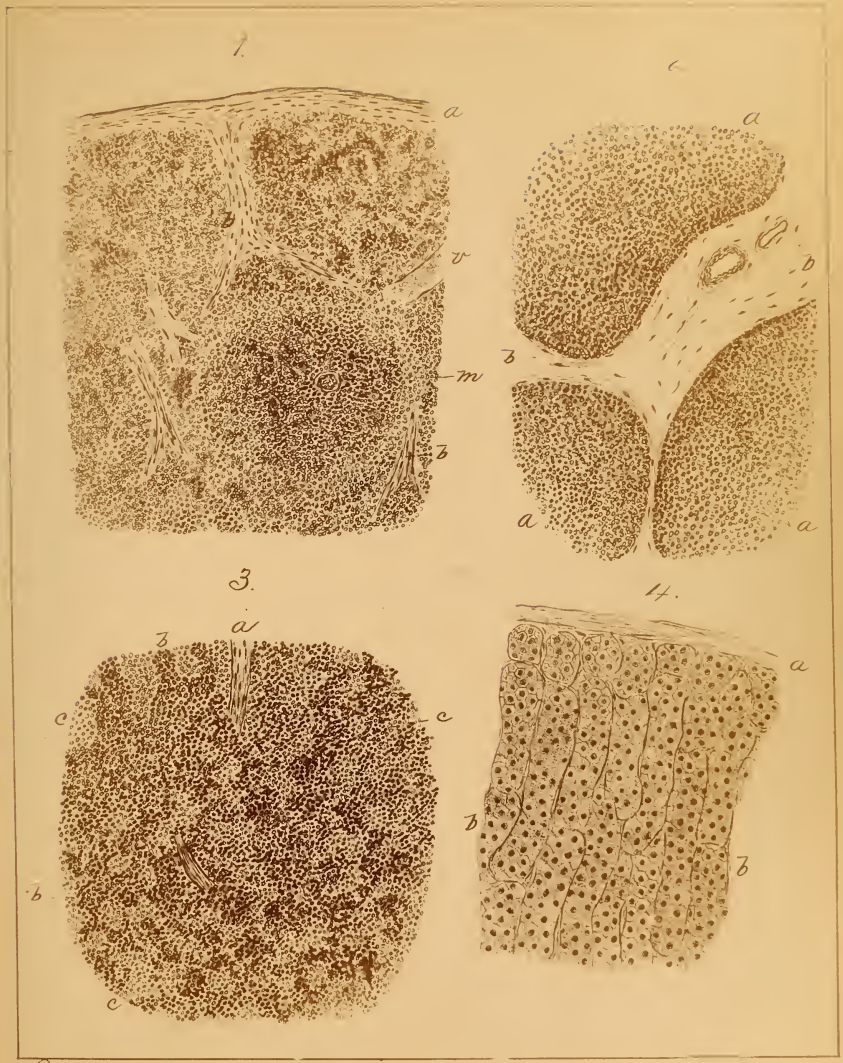
Fig. 1. Section of the spleen, rabbit; × 80. Hæmatoxylin. *a*, fibro-muscular *capsule*, sending off the *trabeculæ*, *b*, towards the interior. *m*, a branch of the splenic artery ensheathed in a dense mass of adenoid tissue—forming a *Malpighian corpuscle*. *v*, blood-vessel.

Fig. 2. Section of the thymus gland, man; × 80. Carmine. *a*, portions of three adjacent lobules of adenoid tissue; *b*, inter-lobular tissue.

Fig. 3. The medulla of a lymphatic gland, rabbit; × 80. Hæmatoxylin. *a*, fragment of a septum. *b*, medullary cords of the denser adenoid tissue. *c*, the parts occupied by looser structure.

Fig. 4. Section of the suprarenal body, man; × 80. Carmine. Only a portion of the cortex is included in the figure. *a*, capsule. *b*, sections of the columnar masses of cells, limited by the septa of connective-tissue.

PLATE XXXIV.



LYMPHATIC GLANDS AND SUPRARENAL BODY.

PLATE XXXV.

THE RESPIRATORY ORGANS.

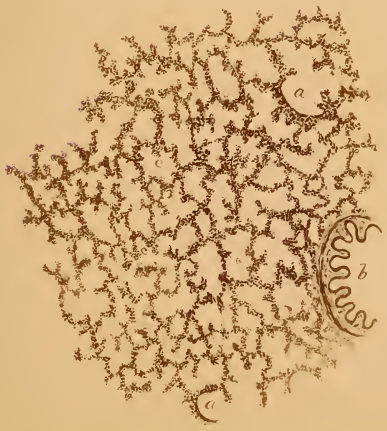
Fig. 1. Section of the trachea, child; × 65. Hæmatoxylin. *a*, stratified ciliated columnar epithelium, resting upon, *b*, the basement membrane. *c*, the fibro-elastic tissue of the mucous membrane. *d*, the loose submucosa, containing *g*, the glands. *e*, the cartilaginous ring.

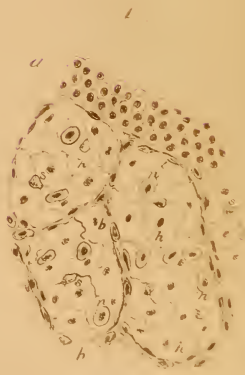
Fig. 2. Section of injected lung, cat; × 20. Carmine-gelatine. After injection the organ has been inflated.

Fig. 3. Section of lung, dog; × 65. Carmine. *a*, section of a terminal *infundibulum*. *b*, a small bronchial tube. *c*, *air-vesicles*, partially collapsed.

Fig. 4. Section of lung, kitten; × 170. Silver and hæmatoxylin. *a*, small quadrate cells of the infundibulum. *b*, inter-vesicular septum. *h*, the flat epithelial cells, lining the air-vesicles, the outlines of the cells being indicated by the silver stained cement-substance. *s*, stigmata. *n*, smaller granular cells—the representatives of those of the infundibulum.

PLATE XXXV.





THE RESPIRATORY ORGANS.

PLATE XXXVI.

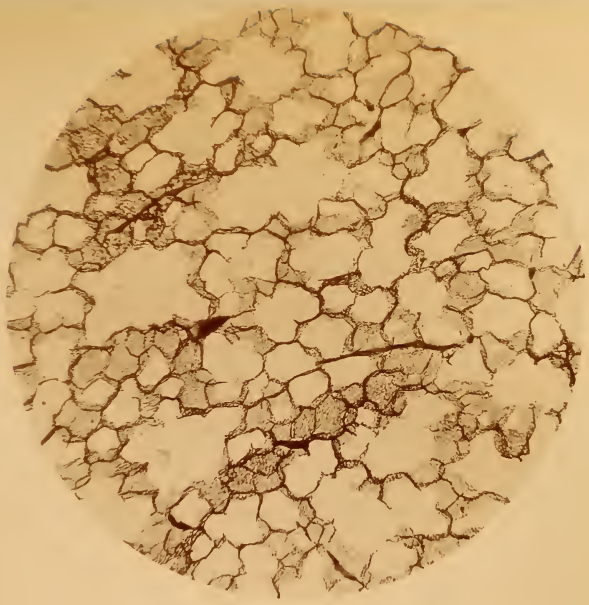
LUNG AND SCALP.

Photo-Micrographs.

Fig. 1. Section of injected and inflated lung, cat; × 35. Vessels have been filled with carmine-gelatine mass, and exhibit the inter-vesicular capillary networks, as well as some larger branches.

Fig. 2. Section of the scalp, child; × 35. Several hair-follicles laid open, displaying the hair-bulbs, with the hairs encased in the root-sheaths.

PLATE XXXVI.



LUNG AND SCALP.

Photo-Micrographs.

PLATE XXXVII.

SKIN AND SCALP.

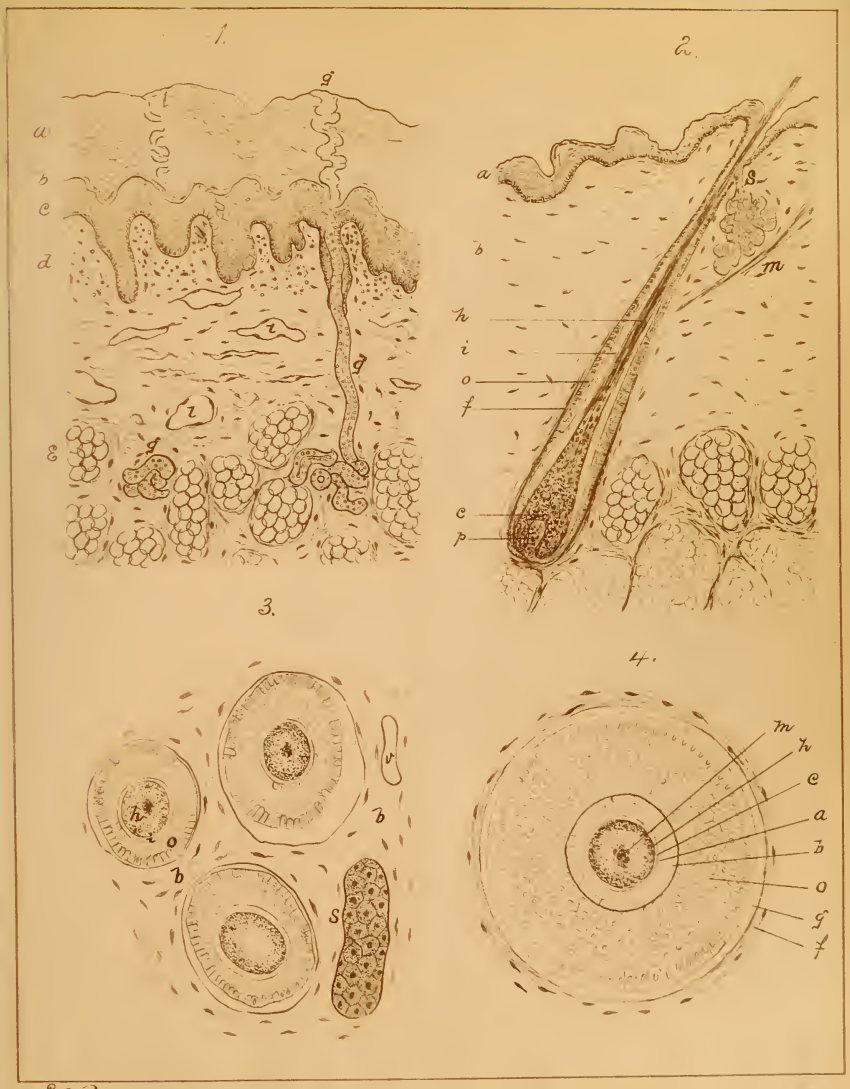
Fig. 1. Section of the skin, finger of child; × 40. Carmine. *a*, *b*, *c*, are, respectively, stratum *corneum*, stratum *lucidum*, and stratum *mucosum* or *Malpighii* of the *epidermis*. *d*, felt-work of the *corium* or true skin, fading into the subjacent *subcutaneous* tissue. *e*, nests of fat-cells. *g*, *sweat* gland, opening on the surface by the spiral duct. *l*, subcutaneous lymph-clefts.

Fig. 2. Section of the scalp, child; × 45. Carmine. *a*, epithelium. *b*, matrix of the scalp. *h*, hair-shaft. *c*, hair-bulb. *i*, *o*, inner and outer root-sheaths. *f*, fibrous envelope of the hair-follicle. *m*, arrector pili muscle. *s*, sebaceous gland.

Fig. 3. Horizontal section of the scalp, man; × 75. Carmine. Sections of three hair-follicles are shown. *h*, hair-shaft, surrounded by *i* and *o*, the inner and outer root-sheaths, shrunken from the wall of the follicle. *s*, a sebaceous gland in section. *b*, subcutaneous tissue. *s*, blood-vessel.

Fig. 4. Semi-diagramatic view of a hair-follicle in transverse section. *m*, *h*, medulla and periphery of the hair. *c*, cuticle of root-sheath. *a*, *b*, layers of Huxley and of Henle of the inner root-sheath. *o*, the outer root-sheath. *g*, hyaline or glassy membrane. *f*, fibrous coat of the follicle.

PLATE XXXVII.



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SKIN AND SCALP.

PLATE XXXVIII.

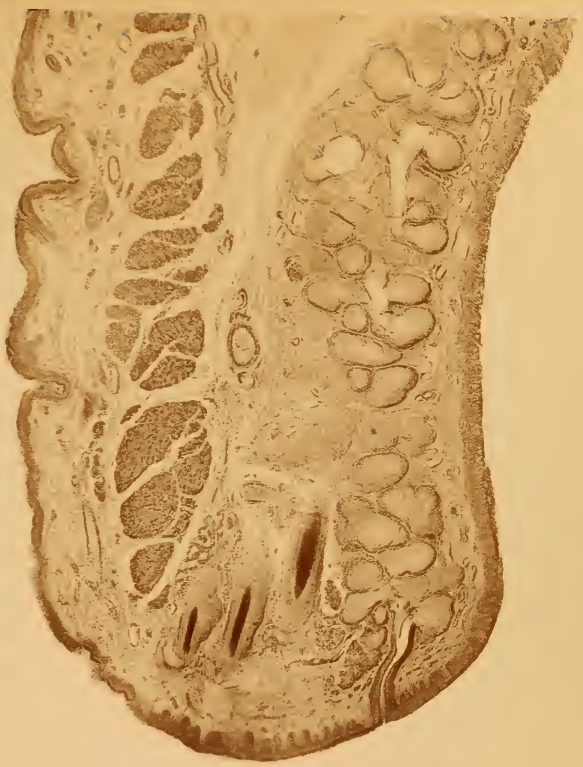
EYELID AND CORNEAL SPACES.

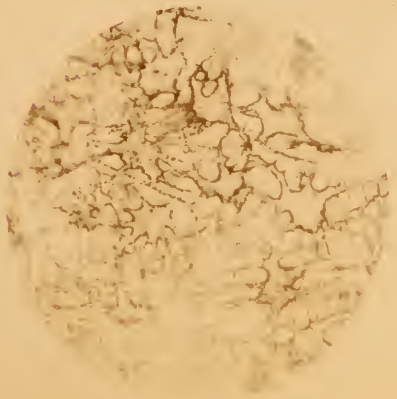
Photo-Micrographs.

Fig. 1. Section of the upper eyelid, child; × 20. Carmine staining. The deeply colored, corrugated skin seen on the left of the figure. Within the subcutaneous tissue, the fibres of the *orbicularis muscle*, cut transversely, appear as dark, irregular areas. Near the conjunctival surface, on the right, are many alveoli of the *Meibomian glands*, with their duct opening upon the free margin of the lid. These glands lie embedded in the compact fibrous tissue, known as the *tarsal cartilage*. Oblique sections of cilia also are seen.

Fig. 2. Separated lamella of the cornea, calf; × 200. Stained by interstitial injection of silver solution. The dark-bordered stellate figures, with long, anastomosing processes, are the *positive* pictures of the corneal spaces. Compare with Fig. 2, Plate VI, which is the corresponding negative.

PLATE XXXVIII.





EYELID AND CORNEAL SPACES.

Photo-Micrographs.

PLATE XXXIX.

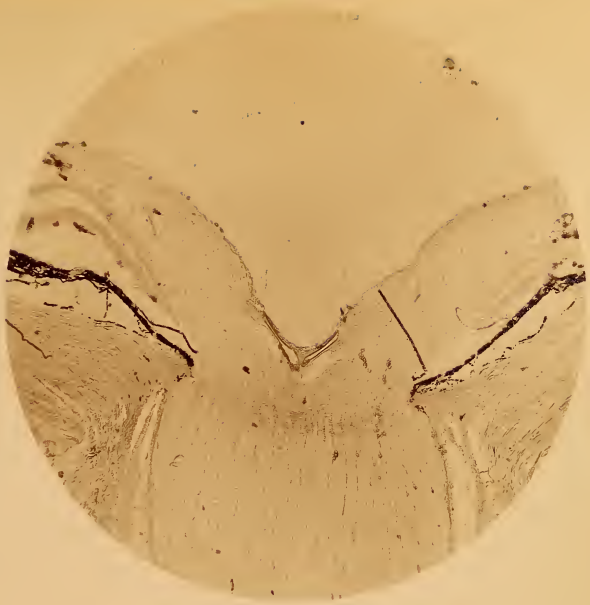
THE EYE:—OPTIC NERVE.

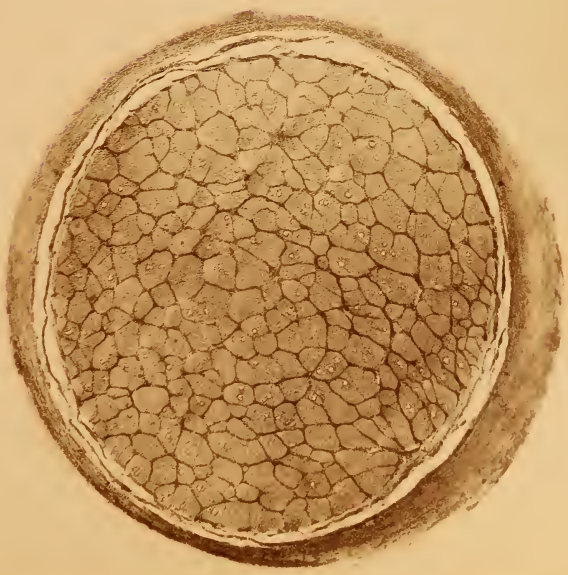
Photo-Micrographs.

Fig. 1. Horizontal section through the posterior segment of the eye, man; × 17. Carmine staining. The section has passed through the optic nerve entrance almost centrally. The nerve seen piercing the sclerotic and choroid coats, and expanding, on either side, into the retina. The latter is somewhat displaced by manipulation. Sections of the vessels of the disk in the centre. Bridging across the nerve, at the point of greatest constriction, the scleral fibres form a felt-work—*lamina cribrosa*—where the medullary sheath of the nerve fibres usually is arrested. At a similar level, terminate, also, the lymph-spaces, which accompany the nerve from the brain. It will be seen, that the pigment layer of retina continues farther towards the nerve than do its companions. A displaced shred of this tissue lies across the retina, on the right side, appearing as a dark line.

Fig. 2. Transverse section of the optic nerve, horse; × 13. Hæmatoxylin staining. The nerve is divided into numerous bundles by the reticulum of connective-tissue, which penetrates among the fibres. The sheaths and lymph-spaces, seen surrounding the nerve, are extensions of the membranes and corresponding spaces of the brain.

PLATE XXXIX.





THE EYE:- Optic Nerve.

Photo-Micrographs.

PLATE XL.

THE EYE.

Photo-Micrographs.

Fig. 1. Section of the cornea, man; × 45. Osmic acid. The upper surface is covered by the *anterior epithelium*, here dark, under which is the *anterior elastic membrane*. The substance proper of the cornea is composed of interlacing bundles of fibrous tissue, in the clefts of which lie the *corneal corpuscles*. The lower surface is clothed with the endothelium, resting against the well defined hyaline *membrane of Descemet*.

Fig. 2. Corneal corpuscles, rabbit; × 250. Gold preparation. A few of the stellate anastomosing cells of a single plane are seen; by their delicate processes they form a rich network.

Fig. 3. Region of the junction of the cornea, sclera, and iris, man; × 45. Osmic acid. Owing to the forward displacement of the iris, the fibres of the pectinate ligament are thrown into loose folds. The irregular channel above is the *canal of Schlemm*.

Fig. 4. Fibres of the crystalline lens, rabbit; × 490. Carmine. The compressed hexagonal figures occupying the field are the fibres in section.

Fig. 5. Section of the retina, calf; × 145. Hæmatoxylin. All the layers of the retina are present, the external layer of *pigment* excepted. Next to the lower edge, the radiating fibres of Müller are seen; these, by the apposition of their expanded bases, produce the *internal limiting membrane*. From below up—from within out, may be recognized the *fibre* layer, *ganglion cells*, *internal granular*, *internal nuclear*, *external granular*, *external nuclear*, *external limiting membrane*, and the *rods and cones*.

PLATE XL.

2.

1.

3.

5.

4.